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Performance Evaluation of Existing Aerated Lagoon System at Consolidated Koshkonong Sanitary District, Edgerton, Wisconsin

Wisconsin Univ -Madison

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Municipal Environmental Research Lab.
Cincinnati, OH

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16. ABSTRACT

Aerated treatment lagoons are used extensively throughout the United States to provide secondary treatment of municipal wastewaters. The data available to assess the performance of these systems are lacking partially as a result of the infrequent sampling and rather limited types of analyses performed routinely. This report presents the evaluation of the performance of a well designed, three cell aerated lagoon system over a twelve month period. The Consolidated Koshkonong Sanitary District's treatment system is located in Wisconsin and is subject to a climate with large seasonal variations. The treatment system performed well in removing BOD_5 and total suspended solids as well as producing an effluent with acceptable pH and coliform counts. Mass balances indicated no removal of phosphorus over the twelve month period. The system was unable to achieve 85 percent removal of BOD_5 and TSS at all times as a result of low influent concentrations during the spring. Phytoplankton concentrations in the effluent during the warm seasons also affected the removal results. Changes in pH and alkalinity in the latter cells indicated that the bicarbonate ion served as a CO_2 source for the phytoplankton growth. Tracer studies showed the mean cell residence time in the primary cell as being 28 percent lower than that calculated by pond volume and flow rate. Phytoplankton populations and decomposition of bottom deposits in the primary pond affected the determination of first order removal rate constants. The treatment system can meet the Federal secondary treatment guidelines as currently defined.

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PERFORMANCE EVALUATION OF EXISTING AERATED LAGOON SYSTEM AT CONSOLIDATED KOSHKONONG SANITARY DISTRICT, EDGERTON, WISCONSIN

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. The complexity of the environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

As part of these activities, this case history report was prepared to make available to the sanitary engineering community a full year of operating and measured performance data for a three-celled, aerated wastewater treatment lagoon system.

Francis T. Mayo, Director
Municipal Environmental Research
Laboratory

ABSTRACT

Aerated treatment lagoons are used extensively throughout the United States to provide secondary treatment of municipal wastewaters. The data available to assess the performance of these systems are lacking partially as a result of the infrequent sampling and rather limited types of analyses performed routinely. This report presents the evaluation of the performance of a well designed, three cell aerated lagoon system over a twelve month period. The Consolidated Koshkonong Sanitary District's treatment system is located in Wisconsin and is subject to a climate with large seasonal variations. The treatment system performed well in removing BOD_5 and total suspended solids as well as producing an effluent with acceptable pH and coliform counts. Mass balances indicated no removal of phosphorus over the twelve month period. The system was unable to achieve 85 percent removal of BOD_5 and TSS at all times as a result of low influent concentrations during the spring. Phytoplankton concentrations in the effluent during the warm seasons also affected the removal results. Changes in pH and alkalinity in the latter cells indicated that the bicarbonate ion served as a CO_2 source for the phytoplankton growth. Tracer studies showed the mean cell residence time in the primary cell as being 28 percent lower than that calculated by pond volume and flow rate. Phytoplankton populations and decomposition of bottom deposits in the primary pond affected the determination of first order removal rate constants. The treatment system can meet the Federal secondary treatment guidelines as currently defined.

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ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

BOD$_5$ --five day 20°C biochemical oxygen demand
cfm --cubic feet per minute
cm --centimeter
COD --chemical oxygen demand
°C --degree Celsius
DI --ductile iron
DO --dissolved oxygen
gpcd --gallons per capita day
gpm --gallons per minute
ha --hectare
kg --kilogram
lcd --liters capita day
LF --lineal feet
m --meters
mgd --million gallons day
MH --manhole
psig --pounds square inch gage
TDH --total discharge head
TSS --total suspended solids
VSS --volatile suspended solids

SYMBOLS

$CaCO_3$ --calcium carbonate
CO_2 --carbon dioxide
Fe --iron
ke --first order rate constant to base e
k_{10} --first order rate constant to base 10
N --nitrogen
NH_3 --ammonia
P --phosphorus

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SECTION 1

INTRODUCTION

The use of aerated lagoon systems represents a low cost method of treatment for many smaller communities where land availability is not of major consequence. The systems have low maintenance requirements and are easy to operate. Also, the systems have the ability to even out the variations in influent quality to a significant degree because of the long detention times and apparently provide relatively high removals of BOD. The data available to assess the performance of these systems is lacking partially due to the infrequent sampling of such systems and the rather limited types of analyses performed which makes it difficult to evaluate the effectiveness of these systems and the factors related thereto.

The purpose of the study reported herein was to determine the performance over a 12-month period on a well-designed, well-operated three-cell aerated lagoon system treating municipal wastewater. In addition, the treatment facilities of the Consolidated Koshkonong Sanitary District located in the upper midwest, represented a facility which would be subject to a climate with large seasonal variations. The performance over the 12-month period would permit the determination of whether or not such a system could meet Federal secondary treatment standards.

SECTION 2

CONCLUSIONS

Based on the results of the 12-month survey of the Consolidated Koshkonong Sanitary District's aerated pond treatment system and associated studies therewith, the following conclusions are made:

1. The wastewater treatment facilities were receiving volumetric and organic loadings well below the design values with flows ranging from 36 to 50 percent of design capacity and BOD_5 loadings varying from 13 to 21 percent of design based on seasonal means.

2. The treated effluent from the pond system met the secondary treatment standards of 30-day and 7-day average values of 30 mg/l and 45 mg/l, respectively, for BOD_5. The standards of 200/ml and 400/ml for 30-day and 7-day geometric means, respectively, for fecal coliform, as originally set out in the Federal Register of August 17, 1973, were met in both the unchlorinated and chlorinated pond effluents. The effluent pH was within the range of 6-9 for all observations.

3. The TSS concentrations in the effluent met the secondary standards as originally set out in the Federal Register of August 17, 1973 for the 4 30-day sampling periods and met the 7-day standards in all but one 7 consecutive day sampling period in May at a time when the algal populations were high.

4. The treatment system did not meet the 85 percent removal requirements in 2 of the 4 30-day sampling periods for BOD_5 and TSS. Failure to do so occurred during the months of April and July when the strength of the influent wastewater was low.

5. The mass balances for phosphorus indicated that the treatment system was unable to reduce the total phosphorus from influent to effluent in the 12-month period. The only reduction that could be affected would be by the retention of insoluble phosphorus forms which did not occur.

6. The first order removal kinetics which were based on wastewater influent and effluent BOD for the primary cell of the

three-cell system resulted in reaction rate constants which did not increase with an increase in water temperature. The phytoplankton populations which exert a BOD and the accelerated decomposition of accumulated bottom deposits during the warmer seasons were contributing factors.

7. The reduction of alkalinity coincidental with the increase in pH for the last two ponds indicated that the bicarbonate ion likely served as the carbon source for the phytoplankton growths.

8. The mean cell residence or detention time for Pond No. 1 as determined by tracer studies was 28 percent lower than the detention time calculated on the basis of inflow and total volume. Pond No. 1 received 60 percent of the air flow delivered to the three-pond system.

9. The air supply to the last two cells of the 3-cell system had limited value as a source of oxygen in that oxygen levels were frequently in excess of saturation for the corresponding water temperature.

10. The removal of organics expressed as BOD_5, COD, TSS, and VSS occurred almost entirely in Pond No. 1 which is likely related to the underloaded condition of the treatment system.

11. The ammonia nitrogen concentrations in the effluent of Pond No. 1 were always higher than the ammonia nitrogen concentrations in the influent as a result of the anaerobic decomposition of accumulated settleable solids in the bottom of the pond.

12. Based on the algal assay studies, the discharge of the effluent to the Rock River in excess of 0.5 percent of the river flow would be required before the nutrients in the effluent would likely have a measureable effect on the algal growth in the river.

SECTION 3

RECOMMENDATIONS

The use of the measurement of suspended solids, representing the non-filterable residue, is not adequate to assess the property of a wastewater effluent because of the non-specific nature of the materials measured. It is well known that suspended solids representing phytoplankton is different than the suspended solids in raw sewage or activated sludge effluents. This understanding was supported by EPA in their revision of the effluent limitations as they pertain to aerated lagoon treatment systems. There remains the need to assess the influence of phytoplankton forms, relative to other secondary effluent suspended forms such as activated sludge, on the receiving environment.

The high D.O. levels in the pond systems make the application of air wasteful of energy for much of the time. The design of the air delivery system should provide for flexibility through the use of several sizes of blowers.

SECTION 4

DESCRIPTION OF THE WASTEWATER COLLECTION AND TREATMENT SYSTEM

The wastewater treatment system provides biological treatment for wastewaters of the Consolidated Koshkonong Sanitary District and was constructed in 1972 and 1973. The boundaries of the District are outlined in Figure 1 wherein the wastewaters are collected from the residences at the western end of Lake Koshkonong and along the Rock River which served as the outlet to Lake Koshkonong. Some dwelling units are occupied on a year around basis whereas others serve for weekend and summer seasonal occupancy.

The collection system consists of 18 wastewater pumping stations and 15850m (52,000 feet) of sewer pipe with sizes ranging from 20.3 to 61 cm (8-24 inch). Most of the sewers are of vitrified clay pipe with reinforced concrete pipe and ductile iron pipe used to a lesser extent where extra strength and protection of private water supply systems was necessary.

The Control Building contains the preliminary treatment facilities and pump station discharge to the aerated pond system. The wastewater is pumped to the three pond, series flow, aerated lagoon systems, thence through chlorination facilities with ultimate discharge to a drainage ditch leading to the Rock River (Figure 2).

The Control building (Figure 3) houses the comminutor, flow measuring device and wastewater pumping station in addition to providing an office, laboratory, meeting rooms, garage and control instrumentation (Figure 4). The wastewater enters the building through a 61 cm (24 inch) gravity sewer passing directly to a comminutor or during times when the comminutor is inoperative the wastewater is directed to a manually cleaned bar screen centrally located as shown in Figures 5 and 6. The right channel is provided for the installation of an additional comminutor in the future (Figure 5). The comminutor, a Worthington Model 12-H-5, is designed to run continuously to cut larger suspended solids to a size that will pass through 0.79 cm (5/16 inch) slots in the comminutor screen (Figure 7). Should the comminutor become clogged or inoperative, the wastewater passes over a short stop baffle directly through the bar rack and into the wetwell without passing through the flow measuring device.

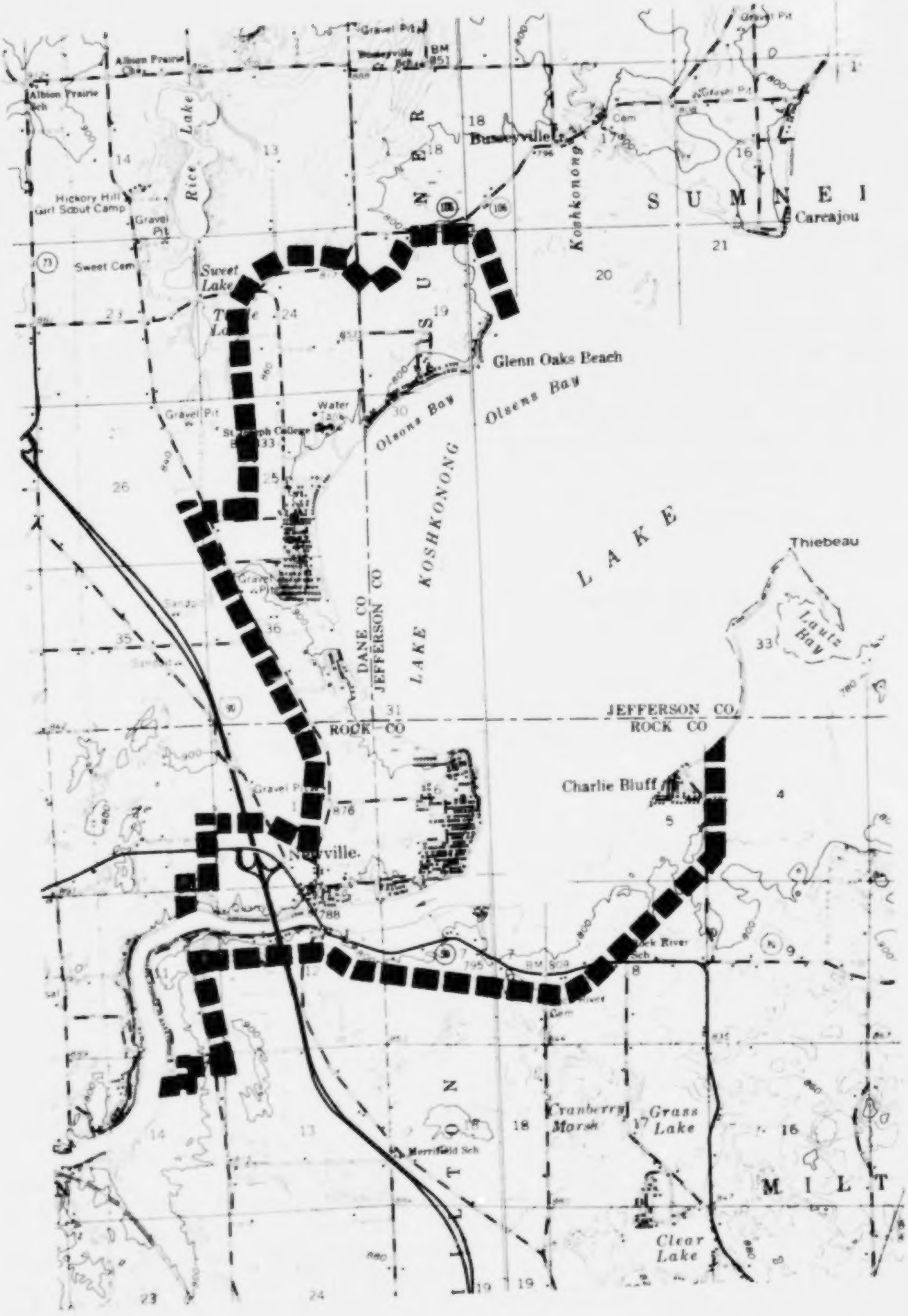
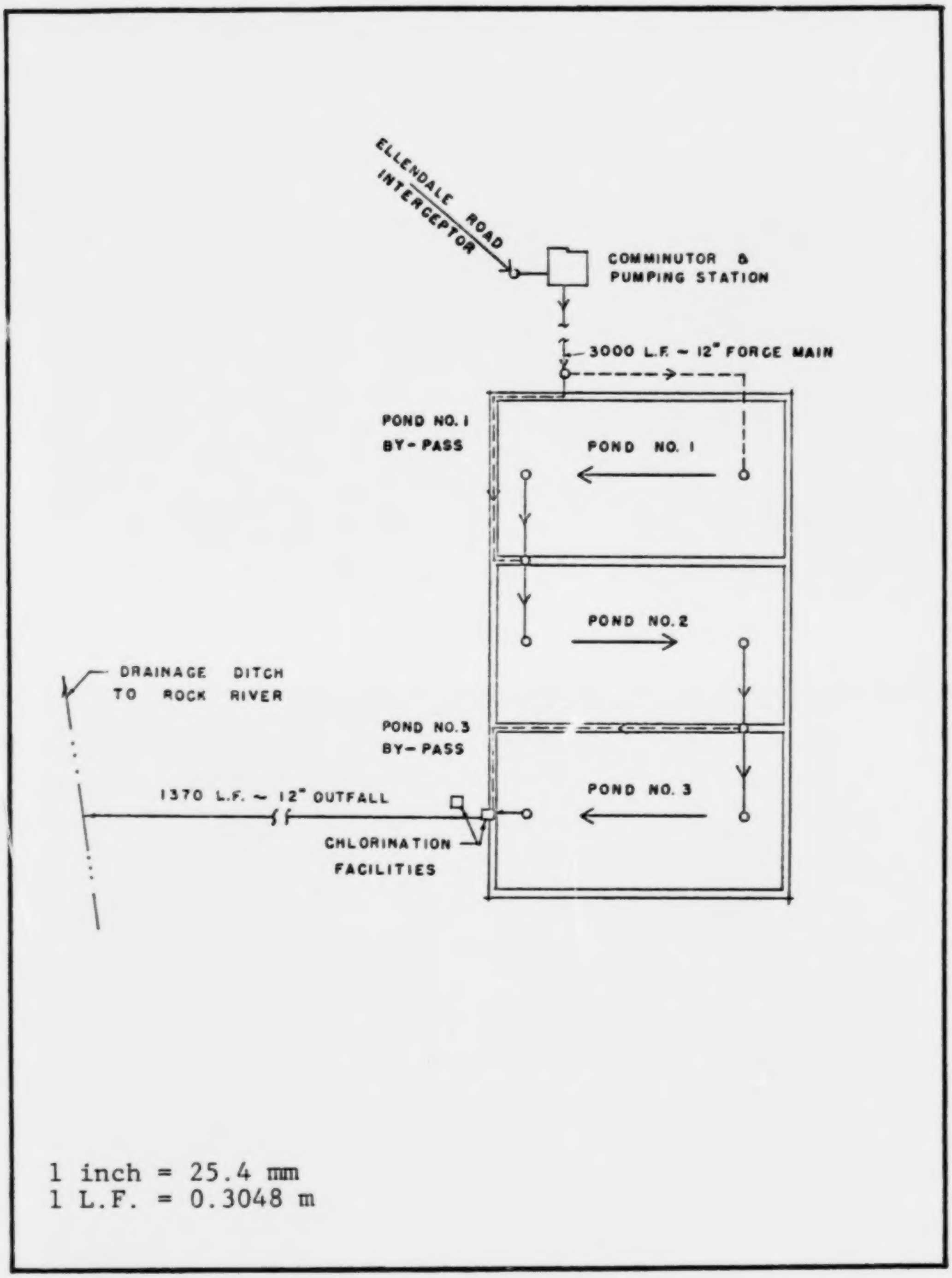

Albion Prairie Sch
Hickory Hill Girl Scout Camp
Rice Lake
Sweet Cem
Sweet Lake
Gravel Pit
St. Joseph College
Water
Busseyville
Koshkonong
S U M N E R
Carcajou
Glenn Oaks Beach
Olsens Bay
LAKE KOSHKONONG
LAKE
Thiebeau
Lautz Bay
DANE CO
JEFFERSON CO
ROCK CO
JEFFERSON CO
ROCK CO
Charlie Bluff
Newville
Cranberry Marsh
Grass Lake
Clear Lake
Merrifield Sch
M I L T O N

Fig. 1. Consolidated Koshkonong Sanitary District.


ELLENDALE ROAD INTERCEPTOR
COMMINUTOR & PUMPING STATION
3000 L.F. ~ 12" FORCE MAIN
POND NO. 1 BY-PASS
POND NO. 1
POND NO. 2
DRAINAGE DITCH TO ROCK RIVER
POND NO. 3 BY-PASS
POND NO. 3
1370 L.F. ~ 12" OUTFALL
CHLORINATION FACILITIES

1 inch = 25.4 mm
1 L.F. = 0.3048 m

Fig. 2. Treatment plant layout.

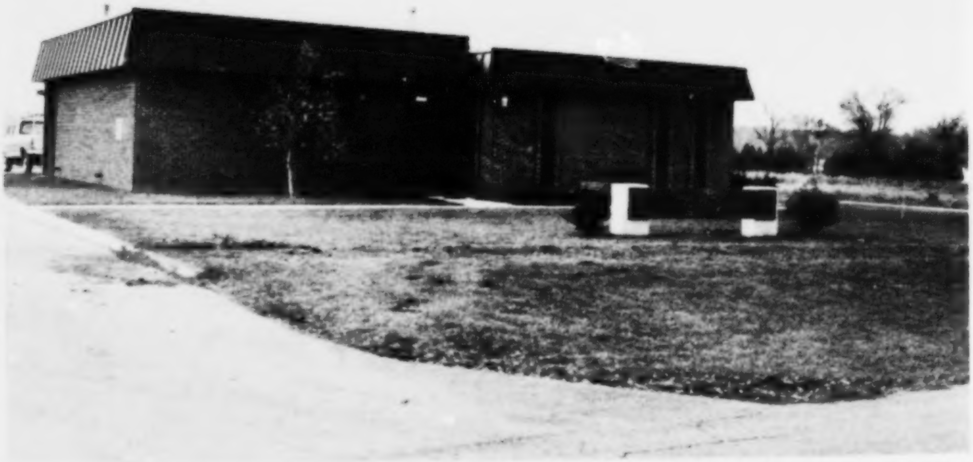


Fig. 3. Preliminary treatment and control building.

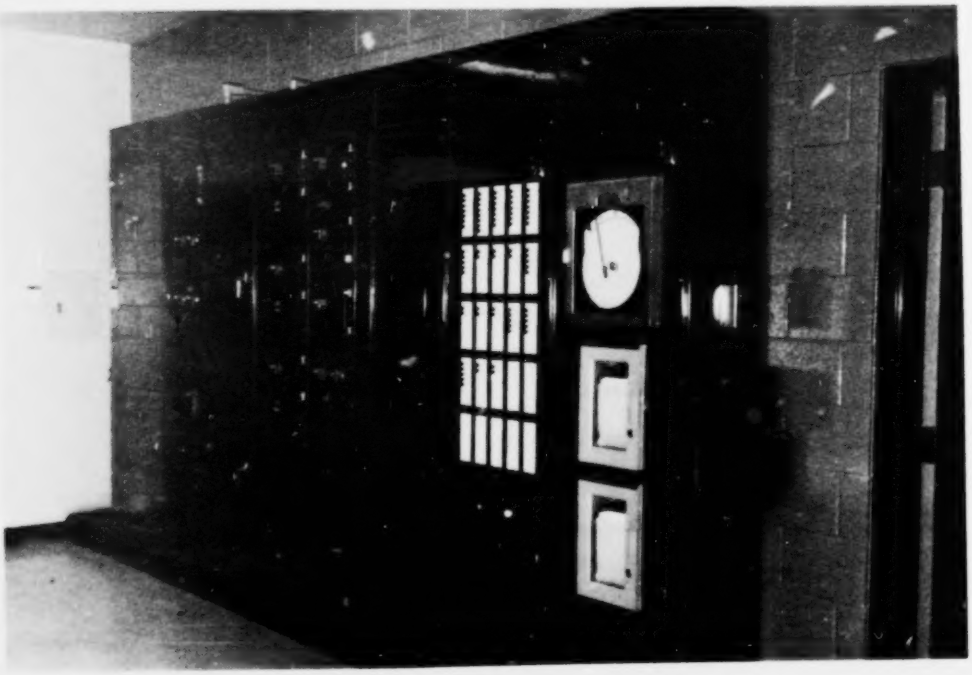


Fig. 4. Treatment control panel.

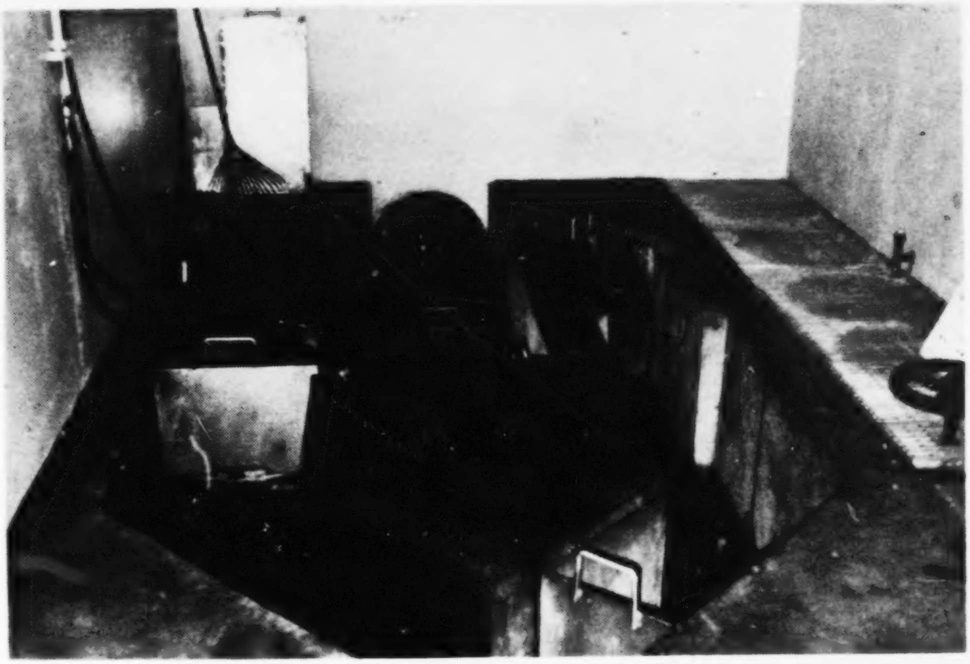


Fig. 5. Wastewater influent chamber.

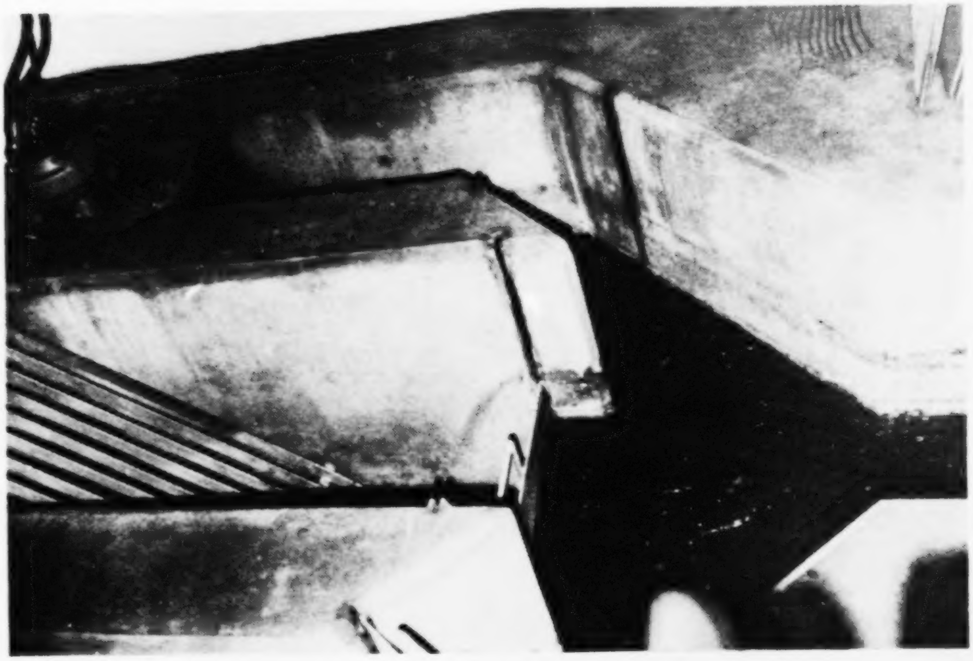


Fig. 6. Comminutor bypass arrangement.

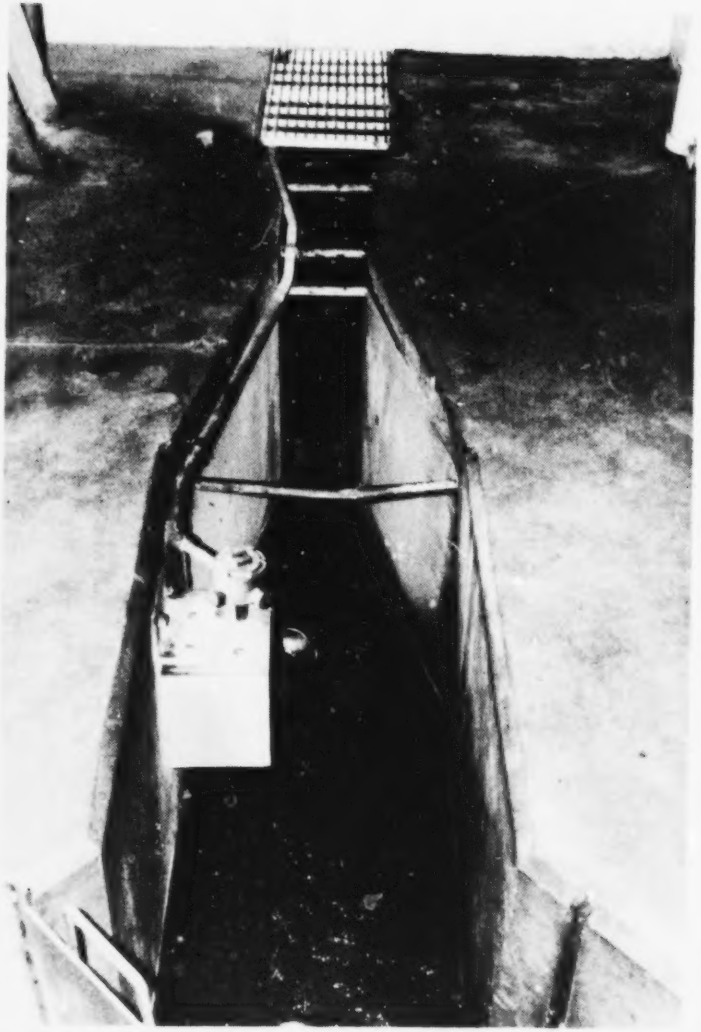


Fig. 7. Parshall flume flow measurement.

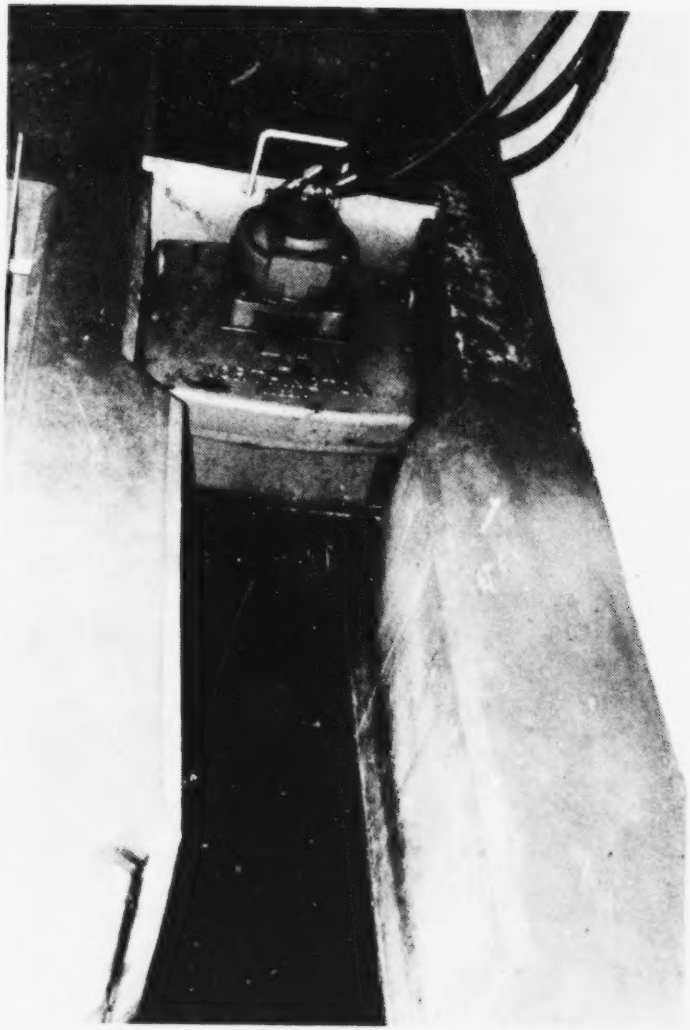


Fig. 8. Comminutor setting.

After comminution, the wastewater passed through a 22.9 cm (9 inch) throat Parshall flume equipped with a float and transmitter located in the flume chamber (Figure 8). The transmitter sends a signal to the flow indicator-recorder-totalizer located in the control panel (Figure 4). The wastewater after passing through the Parshall flume is discharged directly to the wetwell for subsequent pumping through a 30.5 cm (12 inch) 915 m (3000 feet) force main to a valve manhole for direction of the flow into Pond No. 1 or through a bypass for discharge directly into Pond No. 2 (Figure 9).

Under normal operating conditions the three ponds would operate in series with flow discharged directly to Pond No. 1 passing through Pond Control Manhole No. 1 into Pond No. 2 and thence out through Pond Control Manhole No. 2 directly into Pond No. 3 following by flow through the chlorine contact tank (Figure 9). Several bypass arrangements have been provided wherein the comminuted wastewater could pass directly into Pond No. 2 to permit dewatering of Pond No. 1 or to bypass the effluent from Pond No. 2 directly to the chlorine contact tank and thereby bypass Pond No. 3 for purposes of dewatering. No provision was made which would permit a minimum operation of 2 ponds in series with Pond No. 2 out of service. A 6.35 cm (2.5 inch) plastic recirculation suction pipe connected to an airlift pump 7.62 cm (3 inch) for recirculating the contents of Pond No. 2 back to Pond No. 1 was provided in the design but was not used during the course of this investigation (Figure 9).

The pond dikes were constructed of native soil materials with the inside surface sealed with a 30.5 cm (12 inch) layer of compacted clay. A rip-rap band 20.3 cm (8 inch) thick of 7.62 cm (3 inch) rock extended from 30.5 cm (12 inch) below to 45.7 cm (18 inch) above the normal operating water level to protect the dikes from wave action.

The inlet structure for each pond consisted of an upturned elbow which extended to the bottom of the pond and had an inlet opening 0.61 by 0.91 m (2 by 3 feet). The outlet for each pond consisted of an upturned elbow which extended 1.52 m (5 feet) above the pond bottom. The normal water depth in the ponds was 3.05 m (10 feet) which was maintained in Ponds No. 1 and No. 2 by an upturned elbow and flare riser located in the pond control manholes No. 1 and No. 2. The weir located in the chlorine contact tank served as the control to maintain a normal water depth of approximately 3.05 m (10 feet) for Pond No. 3. The inlet and outlet structures were so provided which prevented the backflow of the contents from one pond to the preceding or upstream pond.

The chlorine contact tank has an around-the-end flow baffled arrangement which provides a detention time of 15.4 minutes at 125 percent of the average design flow (Figure 10). The water depth is 2.38 m (7.8 feet) and the discharge end is equipped with

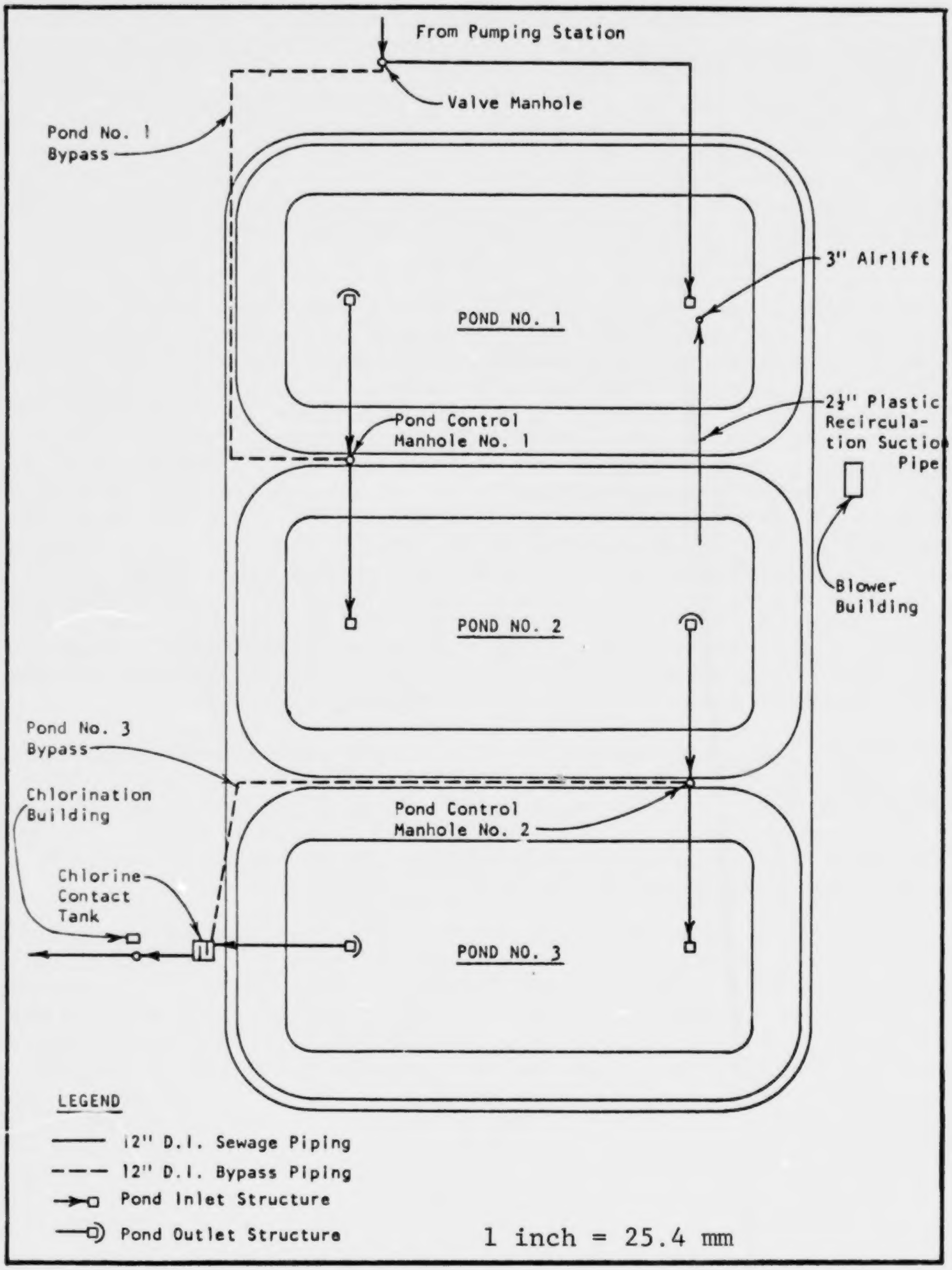

From Pumping Station
Valve Manhole
Pond No. 1 Bypass
3" Airlift
POND NO. 1
2½" Plastic Recircula-tion Suctio Pipe
Pond Control Manhole No. 1
Blower Building
POND NO. 2
Pond No. 3 Bypass
Chlorination Building
Pond Control Manhole No. 2
Chlorine Contact Tank
POND NO. 3
LEGEND
12" D.I. Sewage Piping
12" D.I. Bypass Piping
Pond Inlet Structure
Pond Outlet Structure
1 inch = 25.4 mm

Fig. 9. Aeration pond system.

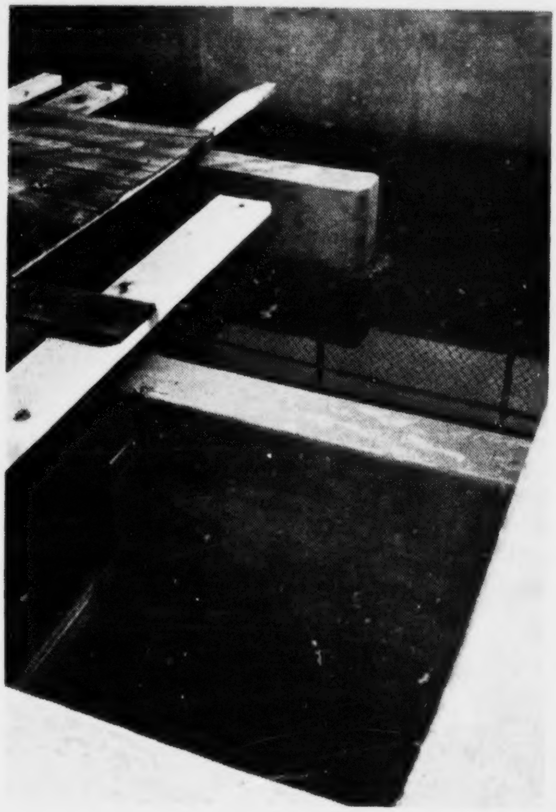


Fig. 10. Chlorine contact tank.

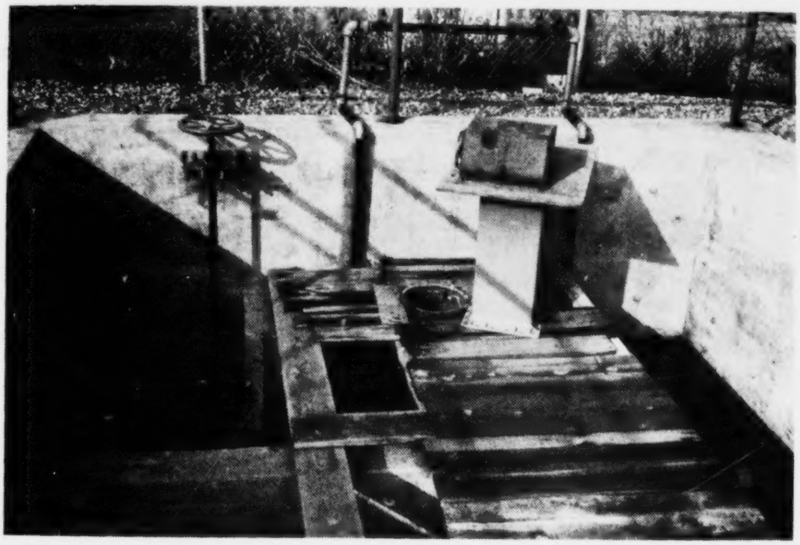


Fig. 11. Stage level recorder for effluent flow measurements.

0.61 m (2 feet) weir plate capable of providing flow measurements with the aid of a stage level recorder (Figure 11). Wastewater enters the head end of the chlorine contact tank through a 30.5 cm (12 inch) ductile iron (D.I.) line from Pond No. 3. The tank can be drained by a 15.2 cm (6 inch) gate valve located at the bottom of the tank.

The chlorination building contains the chlorinator and effluent sampling equipment (Figure 12). The chlorinator, a wall mounted solution feed Advance Gas Chlorinator Model 201, is capable of delivering a maximum of 45.4 kg (100 pounds) of chlorine per 24 hours. The chlorination system consists of an ejector pump, ejector, chlorine cylinders, chlorinator and diffuser. A portion of the system is shown in Figure 13. A manifold assembly, capable of servicing two 68.1 kg (150 pound) chlorine cylinders, is equipped with a 25 watt silicone rubber heater attached to the bottom leg of the manifold to provide heat of vaporization. A scale capable of handling 2 cylinders is used to determine the amount of remaining chlorine gas. The entire gas system, from cylinder to ejector, operates under a vacuum with provisions for stopping the flow of chlorine if the water supply to the ejectors is stopped.

The air supply to the aerated ponds is provided by two identical rotary positive displacement blowers located in a blower building adjacent to the aeration ponds (Figures 9, 14 and 15). Each blower with a rated capacity of 19.1 m^3/min. (674 cfm) of air at a discharge pressure of 0.633 kg/cm^2 (9 psig) and a blower speed of 930 RPM, is capable of supplying the entire air requirement for the treatment facilities. Each manually operated blower has an inlet filter and snubber, flexible couplings for both inlet and outlet piping, thermometer, pressure relief valve, check valve and butterfly valves (Figures 14, 15 and 16). A single common discharge pressure manometer was provided. The blowers discharge into a common air header (Figure 17) from which seven individually valved D.I. air lines lead from the air header to the ponds. Two 10.2 cm (4 inch) laterals lead to Pond No. 1, two 7.62 cm (3 inch) laterals lead to each of Pond No.s 2 and 3, and a single 2.54 cm (1 inch) lateral at the end of the air header leads to the air lift in Pond No. 1. The air lift pump with the recirculation feature was not used during the course of the study.

The air diffusion piping to each of the ponds is shown in Figure 18 wherein the D.I. air lines leading to each pond are buried below the frost line and extend into each pond approximately 0.76 m (2.5 feet) below the normal water level in each pond. The D.I. lines are connected to plastic feeder pipes located along the sides of the pond approximately 1.22 m (4 feet) below the normal water level and anchored to the pond slope by posts placed 3.05 m (10 feet) on center. The air passes from the plastic feeder pipe which serves as a header to weighted

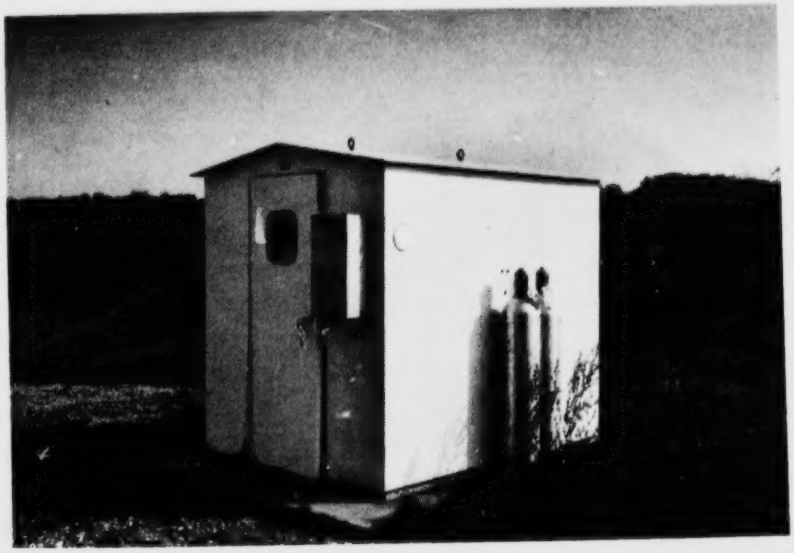


Fig. 12. Chlorine house and sampling structure.

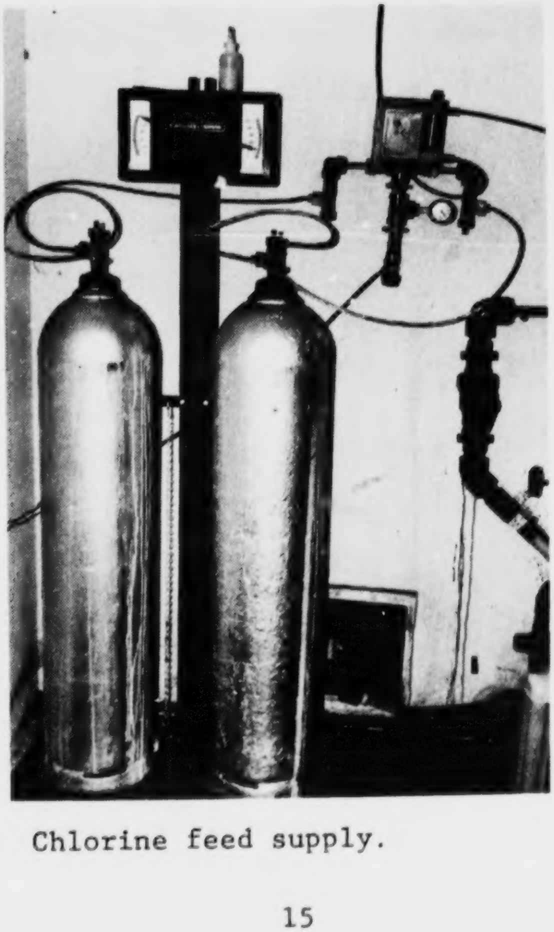


Fig. 13. Chlorine feed supply.

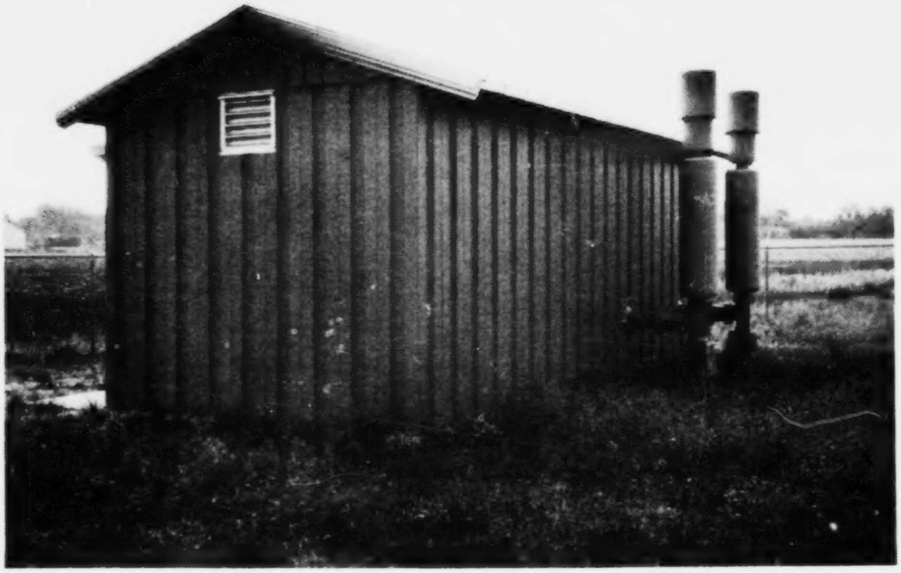


Fig. 14. Blower building.

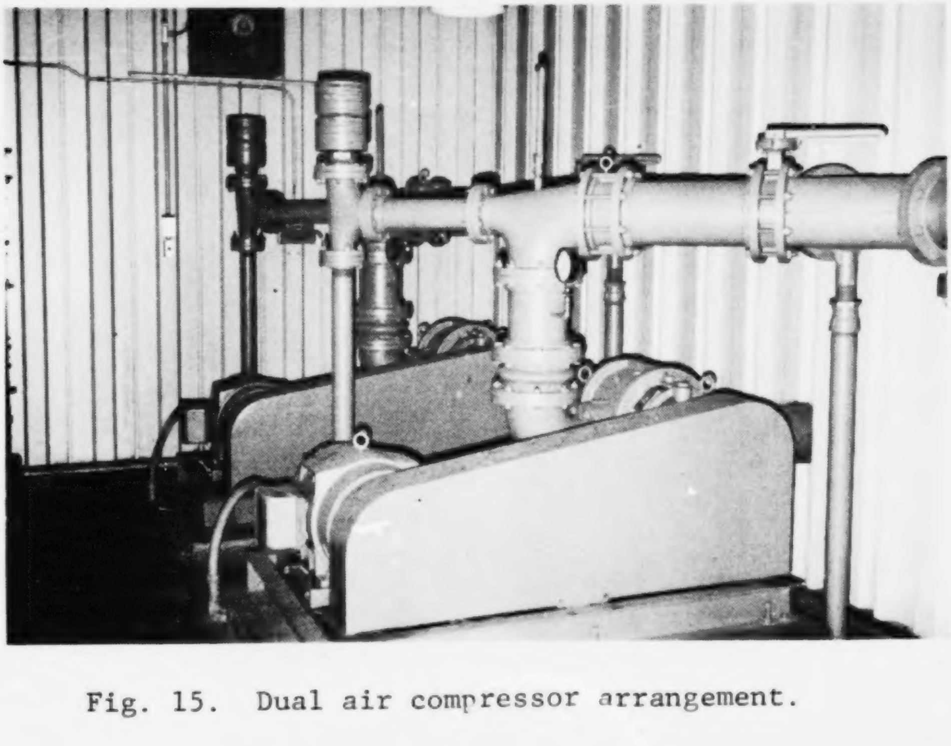


Fig. 15. Dual air compressor arrangement.

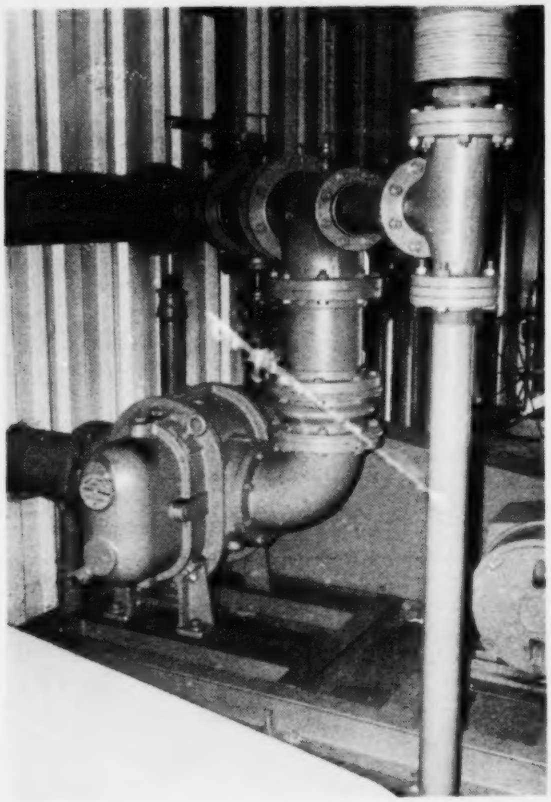


Fig. 16. Rotary positive displacement blower.

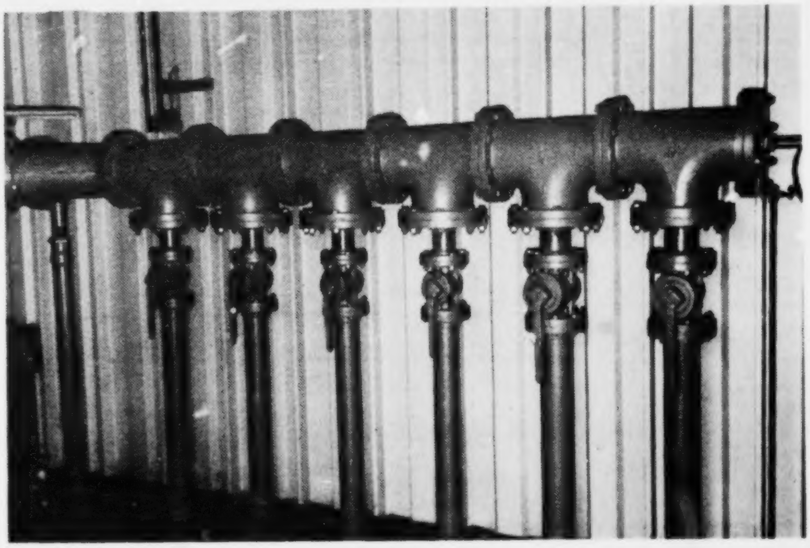


Fig. 17. Six ductile iron aeration laterals.

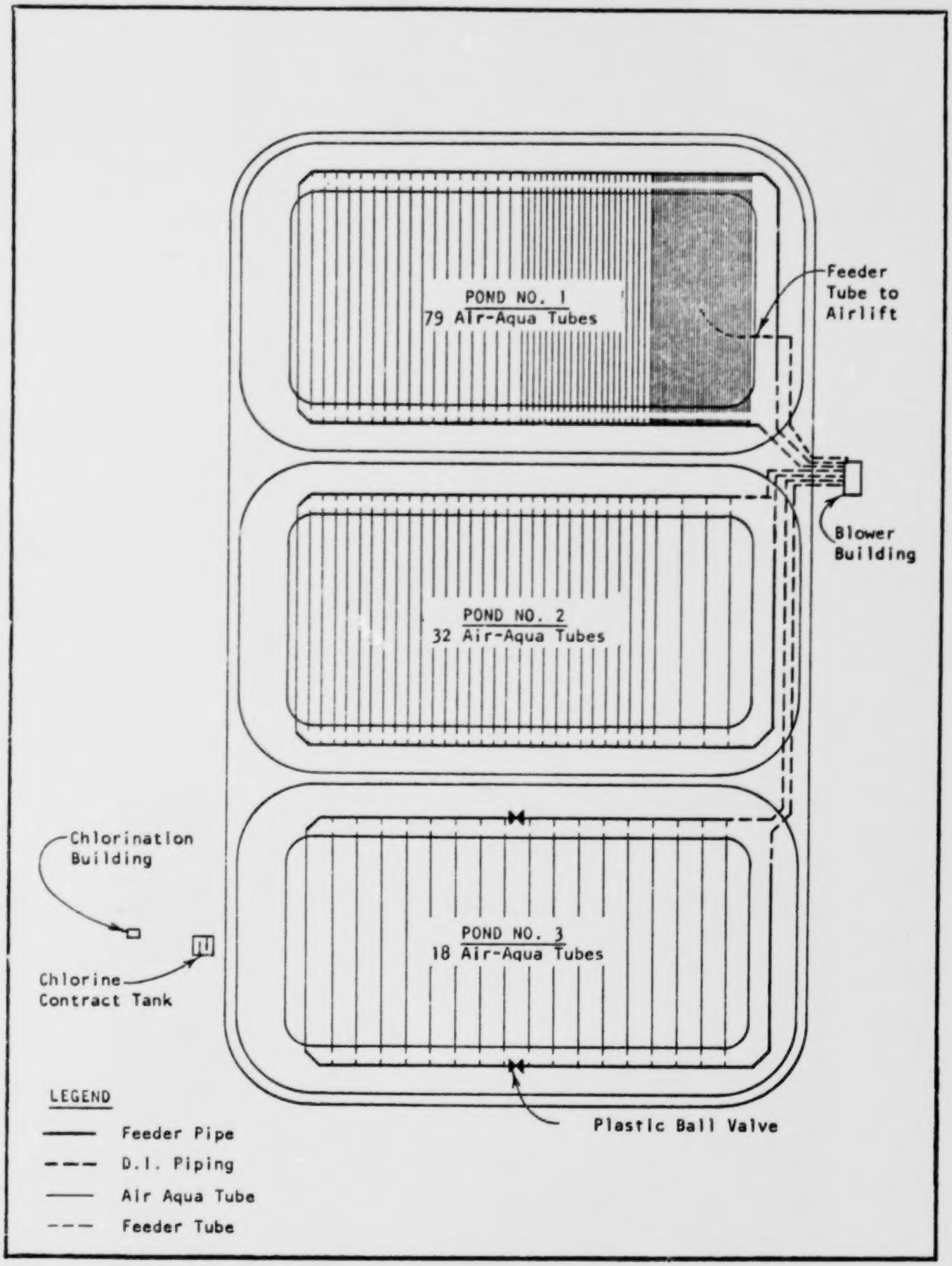

POND NO. 1
79 Air-Aqua Tubes
Feeder Tube to Airlift
Blower Building
POND NO. 2
32 Air-Aqua Tubes
POND NO. 3
18 Air-Aqua Tubes
Chlorination Building
Chlorine Contract Tank
Plastic Ball Valve
LEGEND
Feeder Pipe
D.I. Piping
Air Aqua Tube
Feeder Tube

Fig. 18. Aeration tube arrangement.

feeder tubes, about 5.5m (18 feet) long laid on the pond slope extending to the bottom of each pond and there attached to Hinde weighted air-aqua tubes. The air-aqua tubes are approximately 52 m (170 feet) long laid along the bottom of each pond. The number and spacing of the air-aqua tubing for each pond is tabulated below and shown in Figure 18.

Pond	No. of Air-Aqua Lines	Approximate No. of Meters	Percent of Total	Air-Aqua Spacing, m.
No. 1	79	4100	61	0.61, 152 and 3.05
No. 2	32	1660	25	3.05 and 6.10
No. 3	18	945	14	6.10
	129	6705	100	

The air-aqua aeration tubing is preweighted with a lead keel to position the air inlet orifices at the top of the tubing. The orifices are located on 3.81 cm (1.5 inch) spacings and each orifice has a check valve so as to release about 20 bubbles per second under normal operating conditions. The delivery of air to the ponds is assumed to be proportional to the length of air-aqua tubing with associated air inlet orifices when subject to the same depth of submersion. Control of air can be exercised to a limited extent by the use of valving from the air discharge header pipe in the blower building.

Two 5.08 cm (2 inch) plastic ball valves are provided in the feeder pipes along the sides of Pond No. 3 located at midlength. Should the D.O. levels be sufficient, the air supply to the last half of Pond No. 3 could be cut off to allow settling to take place to facilitate suspended solids removal. This feature was not used during the course of this study.

A summary of the design criteria for the treatment system follows:

TABLE 1. TREATMENT PLANT SIZING

Design Loadings

Design population - 6000 population
Average daily design flow - 378.5 lcd (100 gpcd)
2271 m^3/D (0.6 mgd)
Design BOD_5 - 77.2 g/person-day (0.17 Lb/person-day)
463 kg/d (1020 Lb/d)
Comminutor - maximum flow 7570 m^3/d (2.0 mgd)
Parshall flume - throat width 23.1 cm (9 inch)
Raw sewage pumps - (3 + 1 future)
Each capacity 2.0 m^3/min. (525 gpm), TDH 12.8 m (42 feet)

(continued)

TABLE 1 (continued)

Aerated Ponds (3), values given for each identical pond.

Side slopes 3:1
Freeboard 0.91 m (3 feet)
Water depth 3.05 m (10 feet)
Bottom area/pond

$51.82 \times 112.8 = 5845\ m^2$
$(170 \times 370\ \text{feet} = 62{,}900\ \text{feet}^2)$

Surface area/pond

$70.1 \times 131.1 = 9190\ m^2$
$(230 \times 430\ \text{feet} = 98{,}900\ \text{feet}^2)$

Volume/pond 2290 m^3 (6.05 Mg)
Detention time/pond 10 days at average daily flow

Aeration Tubing (Hinde)

Pond No. 1	79 air-aqua tubes
Pond No. 2	32 air-aqua tubes
Pond No. 3	18 air-aqua tubes
	129 air-aqua tubes, 6705 m length

Air Blowers

Rated capacity - 19.1 m^3/min at 0.633 kg/cm^2
(674 cfm/blower at 9.0 psig)

Air Supply

59.3 m^3/kg of influent BOD_5
(950 ft^3/lb of influent BOD_5)

Chlorine Contact Tank

Length 5.18 m (17 feet), width 3.96 m (13 feet), water depth 2.38 m (7.8 feet)
Effective volume - 30.4 m^3 (8026 gallons)
Detention time - 15.4 minutes at 125 percent of average daily design flow

Chlorinator
Maximum capacity 45.4 kg/24 hr (100 lbs/24 hr.)
Maximum chlorine dosage - 16 mg/l at 125 percent of average daily design flow

SECTION 5

SAMPLING AND ANALYSES PROCEDURES

Samples were collected at five designated sampling points during the study period as follows:

1. Influent to Pond No. 1
2. Effluent from Pond No. 1
3. Effluent from Pond No. 2
4. Effluent from Pond No. 3
5. Effluent from Chlorine Contact Tank

The raw wastewater was sampled in the Control Building just upstream from the throat of the Parshall flume and the samples were composited in proportion to the raw wastewater flow rate. The sampler used was part of the equipment provided for routine sampling with the sample aliquots deposited into a container under refrigeration.

The samples collected representing the effluent from Pond No. 1 and the effluent from Pond No. 2 were time composited using an N-con Surveyor II Composite sampler with housing and arrangements as shown in Figures 19 through 22. A sampling structure was located over the pond control manhole between the adjacent ponds serving as effluent from one pond and as influent to the next pond. The structures were equipped with electrical power for operating the samplers, refrigerators, space heaters and electrical tapes to protect the sample lines from freezing during cold weather periods. The sample line was placed in the upflow leg of the pond outflow piping and the samples were time composited with the representative sample aliquots stored in a container placed in the refrigeration unit. The sample unit would purge the lines before a sample aliquot was taken.

The sampler for the effluent from Pond No. 3 before chlorination was an N-Con system time composited sampler located in the chlorination building. The samples were refrigerated in similar units.

The chlorinated effluent representing sample point No. 5 was obtained with a sampling system provided with the treatment facilities. The sample was taken near the overflow weir of the chlorine contact tank, time composited and stored under refrigeration.

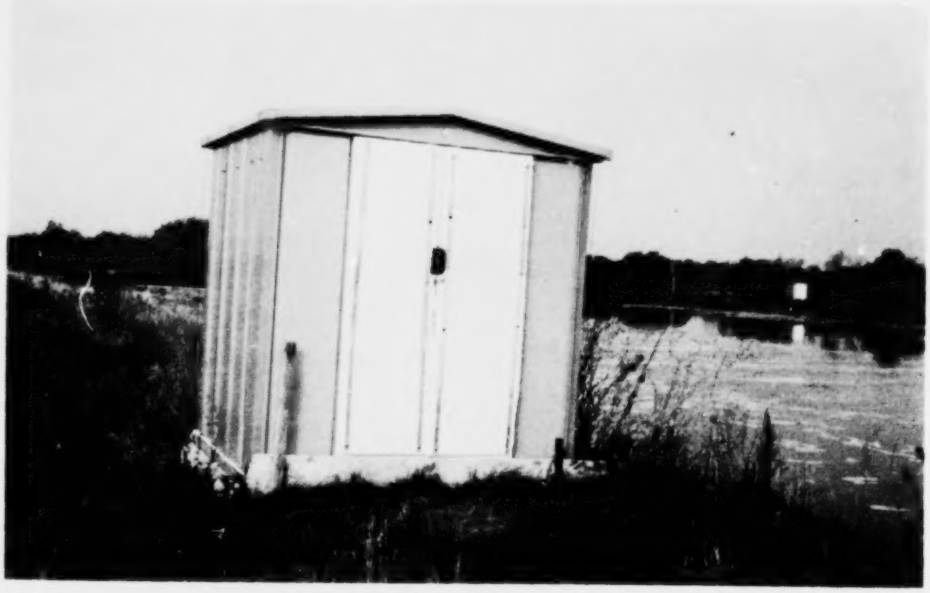


Fig. 19. Sampling structure for Pond No. 2 effluent.

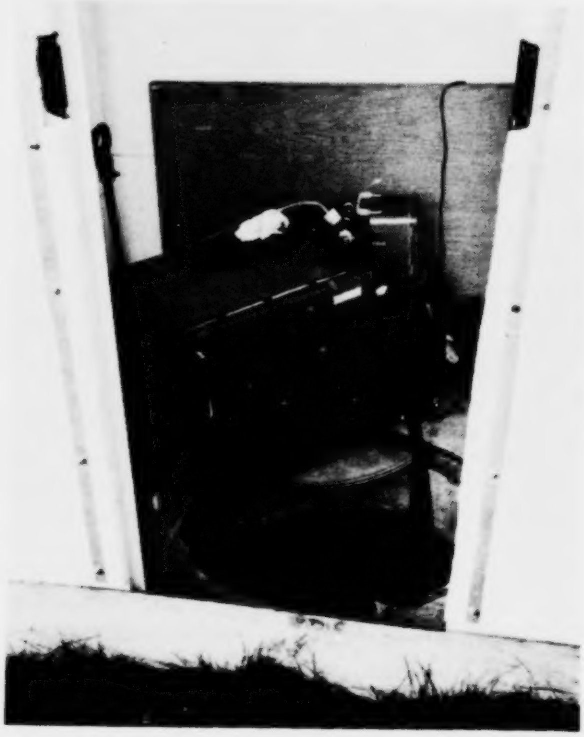


Fig. 20. Sampling equipment arrangement.

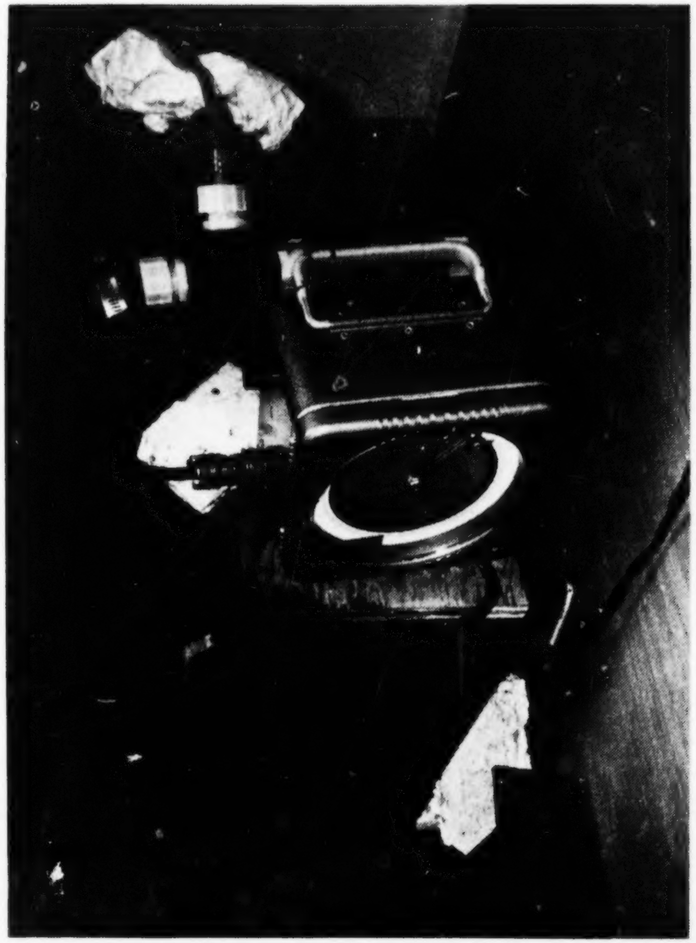


Fig. 21. Sample timer for time composited sampling.

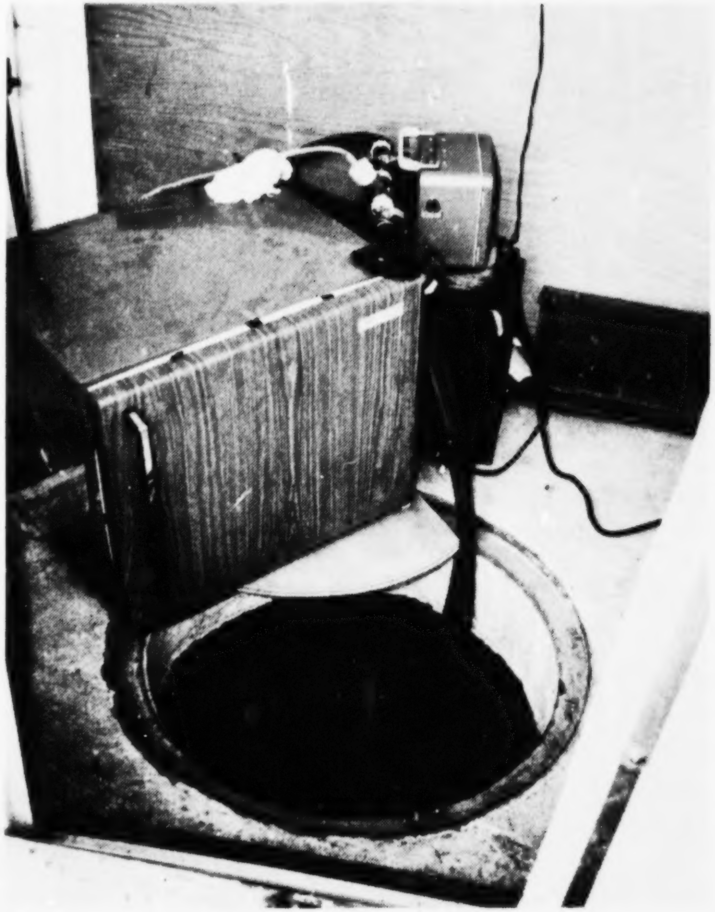


Fig. 22. Sampling manhole and refrigerated sample storage.

The samplers were started each morning at 8:00 AM at the start of a 24-hour sampling period to obtain samples for the various chemical analyses. Certain measurements were performed in situ such as pH, temperature and dissolved oxygen. Also, grab samples were used for the bacteriological analyses of the effluent from Pond No. 3 and the effluent from the chlorine contact tank.

The 24-hour composited samples were divided into two portions, one received a phenol-mecuric-acetate treatment to prevent alterations for the total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N), nitrite nitrogen (NO_2-N), nitrate nitrogen (NO_3-N) and total phosphorus determinations all of which were performed by the University of Wisconsin Soils Laboratory and the other portion was preserved by refrigeration. All samples were transported to the respective laboratories in ice chests within 3 hours of the termination of the 24-hour sample period.

The sampling schedule used in this study is presented in Table 2. Each season, i.e., winter, spring, summer and fall, had two 7-day and one 30-day sampling periods which were used in the seasonal averages. All times were consecutive for each month. The values for the 7-day sampling in November 1975 were included with the fall 1976 sampling periods of 7 days for September and 30 days for October to determine the seasonal mean and standard deviations representing the fall.

TABLE 2. SAMPLING SCHEDULE

Year	Month	Dates	Sampling Period	Season
1975	December	13-19	7 day	Winter
1976	January	3-2/1	30 day	
1976	February	16-22	7 day	
1976	March	13-19	7 day	Spring
1976	April	1-30	30 day	
1976	May	8-14	7 day	
1976	June	21-27	7 day	Summer
1976	July	1-30	30 day	
1976	August	11-17	7 day	
1976	September	18-24	7 day	Fall
1976	October	1-30	30 day	
1975	November	24-30	7 day	

The analytical, physical, and biological observations made with the respective sampling points are presented in Table 3 and the corresponding procedures as well as where and by whom the analyses were performed are presented in Table 4.

TABLE 3. DAILY ANALYSES AND LOCATIONS

Analysis	1 Influent Pond No. 1	2 Effluent Pond No. 1	3 Effluent Pond No. 2	4 Effluent Pond No. 3	5 Effluent Chlorine Contact Tank
Water temperature	x	x	x	x	x
pH	x	x	x	x	x
Alkalinity	x	x	x	x	x
BOD_5	x	x	x	x	x
COD	x	x	x	x	x
Total suspended solids	x	x	x	x	x
Volatile suspended solids	x	x	x	x	x
Total Kjeldahl nitrogen	x	x	x	x	x
Ammonia nitrogen	x	x	x	x	x
Nitrite nitrogen	x	x	x	x	x
Total phosphorus	x	x	x	x	x
Filtered COD	x	x	x	x	x
Dissolved oxygen		x	x	x	x
Fecal coliform				x	x
Fecal streptococci				x	x
Algal cell counts*		x	x	x	

*Cell counts were performed during representative seasonal periods.

TABLE 4. ANALYTICAL PROCEDURES

Analysis	Procedure	Performed by
Water temperature	Thermometer	*in situ* by SEL(1)
pH	pH meter	*in situ* by SEL
Alkalinity	SM(2) 102,P.52	in lab by SEL
BOD_5	SM 219,P.489	in lab by SEL
COD	SM 220,P.495	in lab by SEL
Total suspended solids	SM 224C,P.537	in lab by SEL
Volatile suspended solids	SM 224C,P.537	in lab by SEL
Total Kjeldahl nitrogen	SLP(3)	in lab by SL(4)
Ammonia nitrogen	SLP	in lab by SL
Nitrite nitrogen	SLP	in lab by SL
Nitrate nitrogen	SLP	in lab by SL
Total phosphorus	SM 223C,P.524	in lab by SL
Filtered COD	SM 220, P.495	in lab by SEL
Dissolved oxygen	Y.S.I.D.O.probe	*in situ* by SEL
Fecal coliform	SM 470C,P.669	in lab by SEL
Fecal streptococci	SM	in lab by SEL
Algal cell counts		in lab by G.P.F.(5)

(1) SEL, sanitary engineering laboratory, UW-Madison.

(2) SM, Standard Methods for the Examination of Water and Wastewater, 13th Edition.

(3) SLP, Soils laboratory procedure, Soils laboratory, UW-Madison (Bremmer (1965)).

(4) SL, Soils laboratory, UW-Madison.

(5) G.P.F., all algal analyses performed by G.P. Fitzgerald, Project consultant.

Several of the procedures used were evaluated by the sanitary engineering laboratory personnel to determine the reproducibility of the results. Table 5 presents the analytical results for the COD determination on standards, blanks, influent and Pond No. 3 effluent samples. The precision of the analyses of standards and blanks in the COD determination (0.18 to 0.45 percent of mean) indicated a relatively high reproducibility. Slightly greater variability (0.53 to 1.02 percent of the mean) was encountered when analyses were made of samples of Pond No. 1 influent and Pond No. 3 effluent. For this project the reported COD and filtered COD values can be relied upon to have one percent or less variability from the mean.

TABLE 5. COD REPRODUCIBILITY

Replicates	Standards	Blanks	*Influent 11/6/75	*Effluent No. 3 11/4/75
Date Performed	11/10/75	11/11/75	11/11/75	11/11/75
1	24.40	23.20	20.60	22.70
2	24.20	23.25	20.90	22.50
3	24.25	23.30	20.45	22.55
4	24.40	23.30	20.40	22.40
5	24.10	23.20	20.75	22.50
6	24.20	23.25	20.30	22.50
7	24.20	23.20	20.80	22.60
8	24.15	23.25	20.60	22.30
Mean	24.24	23.24	20.60	22.51
Std. dev.	0.11	0.042	0.21	0.12
Percent of mean	0.45	0.18	1.02	0.53

*Aliquot size 20 ml.

Comparisons were made of the Winkler DO analyses with that of the D.O. probe the results of which are presented in Table 6. The precision for the Winkler method was 0.7 and 1.3 percent for the two series of analyses performed whereas the D.O. by the probe had a value of 0.04 percent of the mean. The measurement of D.O. is a relatively accurate measurement. However, by contrast the measurement of BOD as determined by the difference between the initial D.O. and D.O. after incubation had an 8.3 to 13 percent variability for the wastewater influent and Pond No. 3 effluent, respectively. The results are shown in Table 6. Consequently, as a result of the high variability of this measurement the reported values can be relied upon on to this degree of accuracy.

TABLE 6. DO AND BOD REPRODUCIBILITY

Replicates	Dissolved Oxygen (Blank)			*BOD_5 (DO Difference)	
	Winkler Titration		D.O. Probe	Influent 11/11/75	Effluent No. 3 11/11/75
Date	11/6/75	11/10/75	11/10/75	11/11 and 11/16	11/11 and 11/16
1	8.60	8.95	8.70	6.40	5.15
2	8.70	8.90	8.75	5.05	4.80
3	8.75	8.90	8.75	5.90	4.50
4	8.65	8.90	8.80	5.70	4.60
5	8.70	8.80	8.80	6.15	5.85
6	8.70	8.85	8.75	6.75	4.35
7	8.50	8.75	8.70	6.05	4.25
8	8.90	8.85	8.75	6.10	5.85
Mean	8.69	8.86	8.75	6.01	4.92
Standard deviation	0.116	0.064	0.0038	0.50	0.638
Percent of mean	1.33	0.72	0.04	8.32	13.0

*Reported values represent the DO difference between initial and final DO after 5 days using the DO probe. The influent sample was diluted 20 ml/300 ml whereas the effluent was not diluted.

An evaluation was performed to determine the relationship between chlorophyll a as measured by an Aminco Fluorometer by optical density on acetone extracts of the pond's contents. On two different occasions, 5/27/76 and 9/28/76, extensive sampling of the pond's contents at the surface, the effluent at the outlet points and various locations within the pond were made to provide correlations between algal cell counts, suspended solids and determinations of chlorophyll a. The results of these analytical evaluations are presented in Appendix A. The ratio of fluorometric units to the total suspended solids varied from 9.0 mg/l per fluorometric unit to 15.7 mg/l per unit. The data demonstrate how the ratio of *in vivo* fluorometry for chlorophyll a to suspended solids vary with the different species of algae.

SECTION 6

RESULTS AND DISCUSSION

OPERATING CONDITIONS AND LOADINGS

The general condition of the aerated pond treatment system during the study for warm weather periods is shown in Figures 23 through 28. Pond No. 1 usually would have a partial covering of foam as shown in Figure 23 with light accumulations of floatable organics such as fats and greases along the waterline of the pond (Figure 24). Light amounts of surface foam were usually evident in Pond No. 2 and the water was clear along the waterline with attached phytoplankton growths and free swimming zooplankton (Figures 25, 26 and 27). The water surface of Pond No. 3 was free of foam and surface accumulations but was subject to infestations of muskrats (Figure 28).

During the period of study, problems were encountered with airline breaks as a result of muskrat infestation of the pond areas. The animals would chew through the plastic air tubing resulting in breaks and loss of uniform distribution of the air supplied to the pond. Pond No. 3 was out of service as early as September 1975 before commencing the study for an 18-day period when a broken air line was repaired. From November 6 through the 16th 1975 Pond No. 3 was taken out of service when an air line was repaired. The sampling program commenced on November 24, 1975 and again from June 4 through June 9, Pond No. 3 was out of service for air line repairs. The 7-day sampling period in June started on June 21, some 12 days after Pond No. 3 was returned to service. During the period for repairs the water level of Pond No. 3 was lowered several feet before flow to the pond was resumed. The water levels or displacement through Pond Nos. 1 and 2 were unaffected by these brief interruptions.

The loadings to the treatment system are summarized in Table 7, the values reported represent the mean values of the four seasons of the year. BOD loadings based on volume and surface area, and hydraulic detention times in days, are presented for the primary Pond No. 1 and for the total capacity of the three-pond system. Detention times in Pond No. 1 ranged from 20 to 28 days assuming the completely mixed flow regime with all portions of the pond serving as active volume. The flow to the treatment system during the study as a percent of design flow for the seasonal averages ranged from 49.5 to 36.2 percent

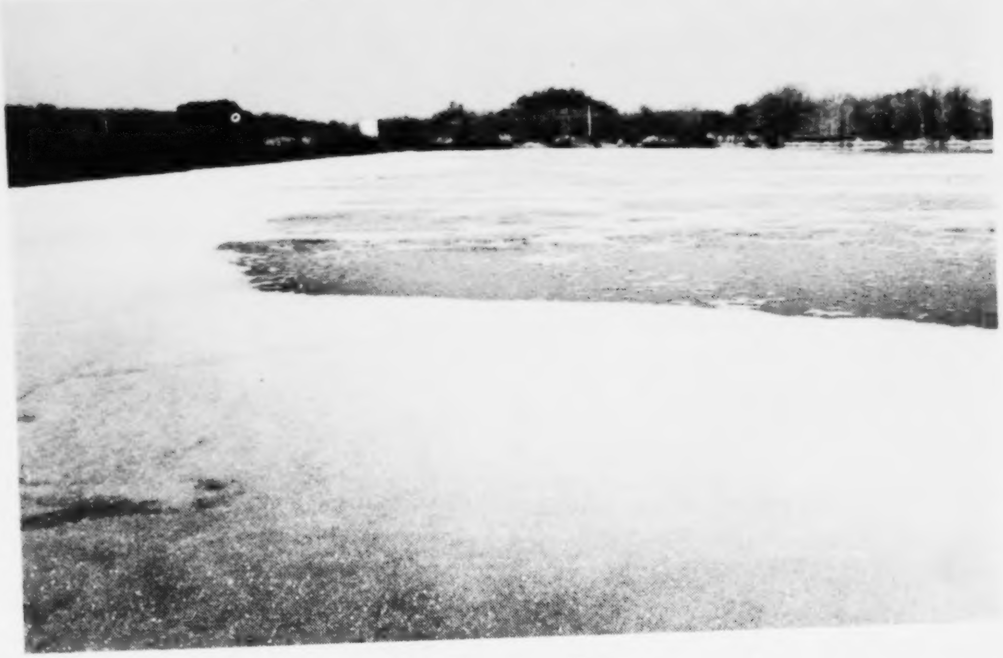


Fig. 23. Pond No. 1 water surface.

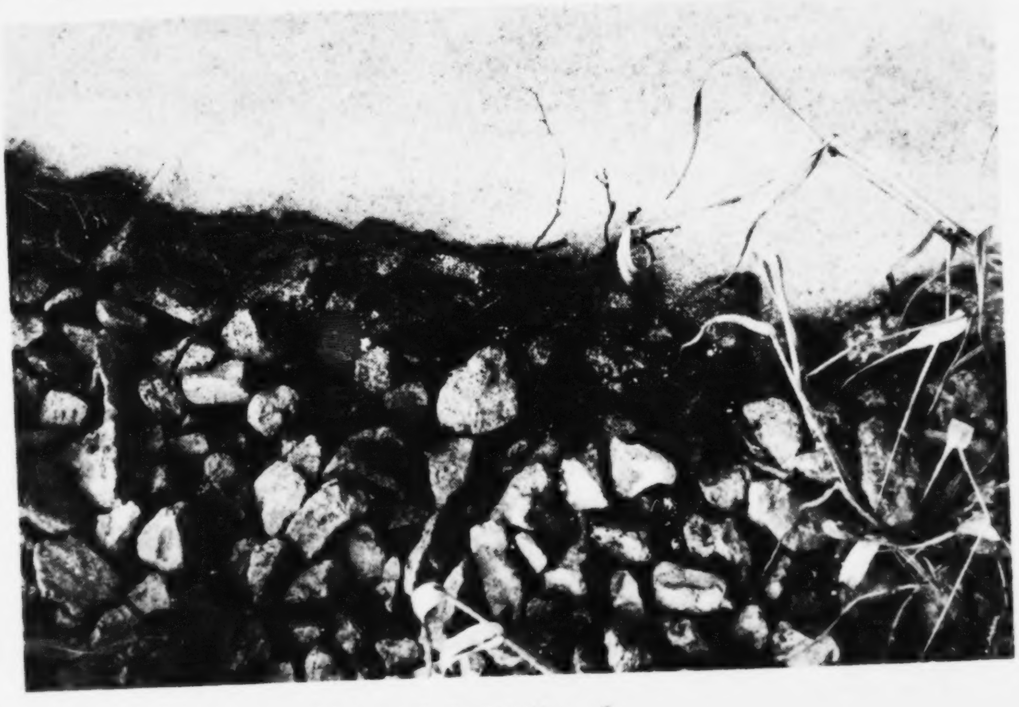


Fig. 24. Waterline of Pond No. 1.

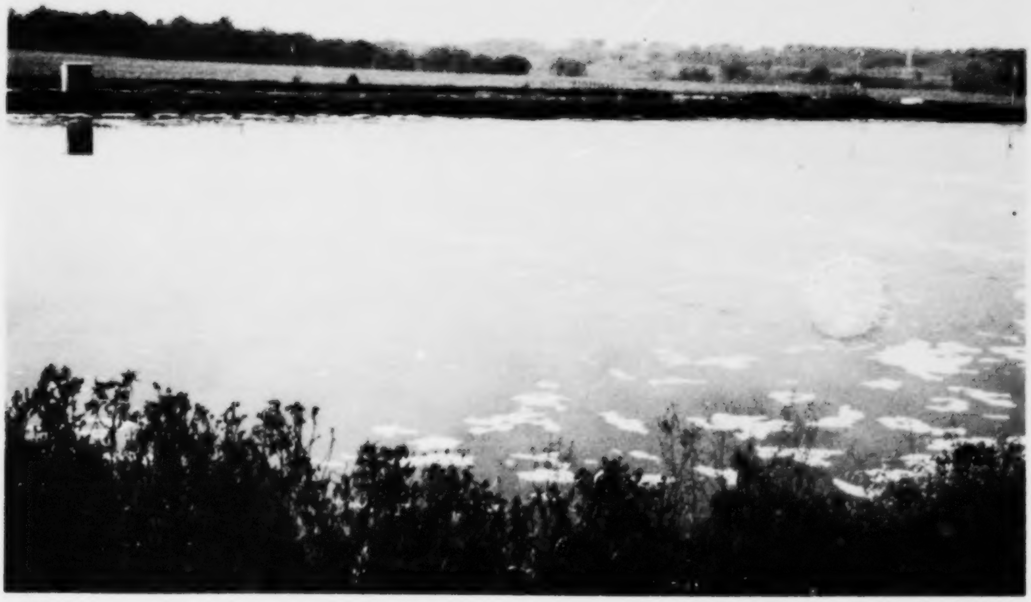


Fig. 25. Pond No. 2 water surface.

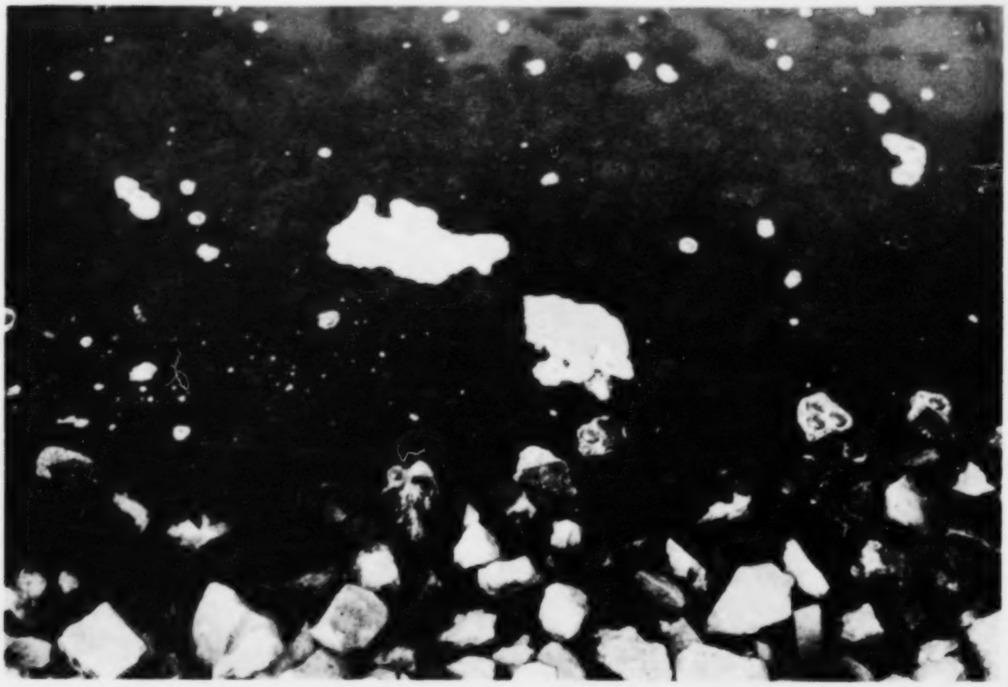


Fig. 26. Waterline of Pond No. 2.

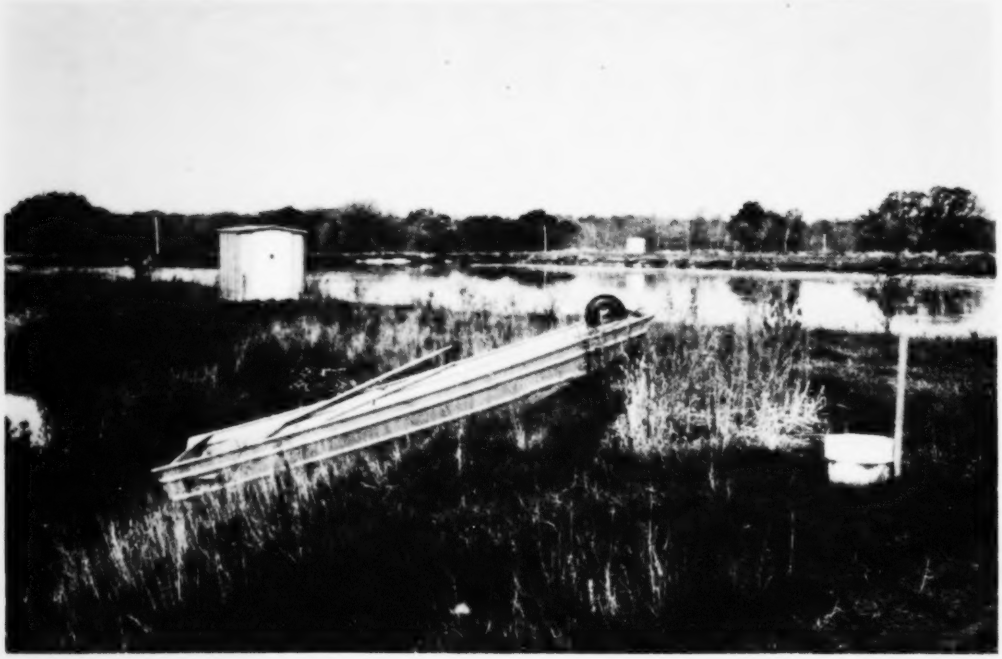


Fig. 27. Pond No. 2 outlet structure and sampling point.

Fig. 28. Pond No. 3 water surface.

TABLE 7. SUMMARY OF TREATMENT SYSTEM LOADING DURING TEST PERIOD

Parameter	Winter		Spring		Summer		Fall	
	a*	b**	a	b	a	b	a	b
Flow m^3D, mgd	821.3	0.217	1124.	0.297	1003.	0.265	874.3	0.231
BOD, mg/l	91.1		54.7		95.5		101.2	
BOD, kg/d, lb/d	74.9	165.	61.3	135.	95.8	211.	88.5	195.
BOD Loading, Volume kg/1000 m^3, lb/1000 ft^3								
Primary Cell	3.27	0.204	2.68	0.167	4.18	0.261	3.86	0.241
Total Volume	1.09	0.068	0.892	0.056	1.39	0.087	1.29	0.080
BOD Loading, Surface kg/ha-d, lb/acre-d								
Primary Cell	81.5	72.7	66.7	59.5	104.2	93.0	96.3	85.9
Total Surface	27.2	24.2	22.2	19.8	34.8	31.0	32.1	28.6
Detention, d								
Primary Cell	27.9		20.4		22.8		26.2	
Total Volume	83.7		61.2		68.4		78.6	
Flow, percent design	36.2		49.5		44.2		38.5	
BOD, percent design	16.2		13.2		20.7		19.1	

*Metric units.

**English units.

whereas the BOD loading which was experienced as a percent of design loading ranged only from 13.2 to 20.7 percent. The BOD strength of the wastewater ranged only from 55 to 101 mg/l, considerably lower strength than was projected for the design BOD loading. The low strength wastewater coincided with the high flow during the spring. Although the entire collection system was newly constructed, it was apparent that infiltration-inflow had a significant effect on the volume and strength of the wastewater. At the same time the loadings, well below design values, should give the expectation for high treatment performance.

AERATED POND PERFORMANCE RELATIVE TO SECONDARY TREATMENT STANDARDS

The following standards were established by EPA for secondary level of treatment for publicly owned facilities to be achieved by July 1977. The aerated pond treatment system represents secondary treatment and one of the objectives of the study was to determine whether these standards could be met on an annual basis particularly for aerated pond systems subject to large seasonal variations of temperature. The standards which were applied to secondary treatment by EPA follow:

a) The 5-day, 20°C biochemical oxygen demand (BOD_5) and total suspended solids (TSS) shall not exceed a mean of 30 mg/l nor 45 mg/l for effluent samples collected over 30 and 7 consecutive day periods, respectively.

b) The mean of effluent BOD_5 and TSS values for samples collected over a 30-day consecutive period shall not exceed 15 percent of the mean of influent BOD_5 and TSS values for samples collected over approximately the same 30 consecutive day period.

c) The geometric mean of fecal coliform bacteria in the effluent shall not exceed 200 per 100 ml or 400 per 100 ml for samples collected during a consecutive period of 30 and 7 days, respectively.

d) The effluent pH value shall be within the limits of 6.0 to 9.0.

Subsequent to the publication of these effluent requirements in the Federal Register on August 17, 1973, the definition of secondary treatment effluent requirements has undergone some modifications. The Federal Register, Vol. 41, No. 144, Monday, July 26, 1976, pp. 30786-30789, contains amendments pertaining to effluent values for pH and deletion of fecal coliform bacteria limitations from the definition of secondary treatment. The Federal Register, Vol. 42, No. 195, Friday, October 7, 1977, pp. 54664-54666, contains changes in the suspended solids requirements for small municipal lagoon systems, i.e. two million gallons per day or less, serving as the sole process for secondary treatment of wastewaters. The treatment works would have to conform to the suspended solids concentrations achievable with "best stabilization pond technology" which means a suspended solids value as determined by the Regional Administration, or State Authority subject to approval, which is equal to the effluent concentration achieved 90 percent of the time which in turn would permit achieving the levels of effluent quality established for BOD and not cause water quality standards to be violated.

The performance of the Consolidated Koshkonong Sanitary District treatment system during the study period is compared with the elucidated standards representing the secondary treatment definitions for 1977 as originally set out in the Federal Register of August 17, 1973. The summary of the results are presented in Table 8 wherein the following observations are made:

a) The effluent BOD_5 met the 30 and 7 consecutive day BOD values of 30 and 45 mg/l, respectively, throughout the test period. The 7 consecutive day period includes all possible combinations during the 30-day period as well as during months when only 7-day sampling was conducted.

b) The effluent TSS met the 30 consecutive day standard of 30 mg/l for the four sampling periods but exceeded the 7-day value of 45 mg/l for one 7-day period during the month of May with a value of 55.0 mg/l.

c) The fecal coliform counts in the effluent easily met the standard for all 30-day and 7-day consecutive periods. The standards were easily met even with the effluent from Pond No. 3 (sample point 4) without the benefit of chlorination.

d) The pH values were well within the range of 6-9 with a minimum recorded value of 7.3 and a maximum value of 8.0.

e) The overall removal of BOD_5 and TSS from influent to effluent did not meet the standard 50 percent of the time, i.e., 2 of the 4 30-day sampling periods for April and July, a removal of 85 percent of the BOD_5 and TSS was not achieved. In April the incoming wastewater was weak (only about 25 percent of the expected design BOD_5 and TSS) consequently, the system being principally a biological system was unable to reduce the BOD and TSS to 8 and 9 mg/l, respectively. During the month of July the incoming wastewater was stronger but it was not possible to achieve BOD and TSS concentrations below 20 mg/l.

TABLE 8. TREATMENT PERFORMANCE RELATIVE TO THE 1977 SECONDARY TREATMENT STANDARDS

Study Period 75-76 Mo. Day	Total BOD_5, Mean			Total Suspended Solids, Mean			Fecal Coliform Geometric Mean		pH Range 6-9	
	30 day 30 mg/1	Percent Removal 85	7 day 45 mg/1	30 day 30 mg/1	Percent Removal 85	7 day 45 mg/1	30 day 200/100 ml	7 day 400/100 ml	min.	max.
11/24-30			3.9			5.3		13.5	7.5	7.6
12/13-19			8.0			4.4		10.0	7.5	7.6
1/3-2/1	10.1	89.5	all	2.8	97.6	all	4.2	all	7.4	7.6
2/16-22			4.7			2.1		7.4	7.3	7.4
3/13-19			10.9			26.3		42.7	7.5	7.6
4/1-30	10.0	81.8*	all	21.8	65.7*	all	4.2	all	7.6	7.8
5/8-14			12.7			55.0*		2.4	8.0	8.2
6/21-27			10.7			19.0		2.0	7.8	7.8
7/1-30	19.5	78.9*	all	22.9	82.7*	all	2.8	all	7.7	7.8
8/11-17			19.0			16.1		2.8	7.6	7.7
9/18-24			17.0			21.0		4.3	7.5	7.7
10/1-30	17.0	85.0	all	8.3	92.7	all	2.3	all	7.4	7.6

Note: *Values exceed standards.

All, each 7-day consecutive period within 30-day sampling period met the requirement.

The results of the analyses for BOD_5, TSS and pH are presented in Figures 29 through 31 for each of the 5 sampling points for the 7-day and 30-day consecutive survey periods. The results of the fecal coliform and fecal streptococci for sampling points 4 and 5 representing Pond No. 3 effluent and chlorine contact tank effluent are presented in Figure 32. With regard to BOD_5 concentration and pH, it is apparent that the standards could be achieved even with the single aerated pond as represented by sample point 2, the effluent from Pond No. 1 (Figures 29 and 31). The TSS in the effluent for Pond No. 1 (sample point 2) as seen in Figure 30 would meet the concentration standard throughout the survey period. However, the TSS concentrations in the effluents from Pond Nos. 2 and 3 for the 7-day period in the month of May exceeded the 45 mg/l standard.

BOD REMOVAL RATE CONSTANTS FOR POND NO. 1

The removal of BOD for a complete mixed biological reactor has been modeled as a first-order reaction as follows:

$$S/S_o = \frac{1}{1 + kt}$$

where:

S = BOD of the effluent, mg/l
S_o = BOD of the influent, mg/l
t = detention time for aerated lagoon in days
k = first-order reaction rate constant in $days^{-1}$

The results of the determination of the reaction rate constants for Pond No. 1 utilizing the mean BOD of the influent and the effluent for each month of the survey are presented in Table 9. The percent removals are noted ranging from 62.6 to 87.4 percent with detention periods ranging from 18.8 to 48.8 days. The k_e values range from 0.098 to 0.263 and appear not to be correlated with the water temperature in Pond No. 1. One would expect a higher k_e value for the higher temperatures but this was not evident in this survey. The values of k_e are somewhat on the low side and in that the removals are based on total BOD, the constant k_e accounts for removal resulting from settling as well as from biological stabilization. Also, the effects of reduced rates of decomposition or solubilization of the settled particulate matter during the winter months with increased activity during the warmer spring months and high flows of weaker wastewater could cause the k_e values to decrease with an increase in temperature. Also, the phytoplankton populations are higher during the warmer water temperatures and they in turn exert a BOD which would result in a higher BOD in the effluent and thus a lower rate constant. In addition, the detention time in Pond No. 1 may be less than the nominal detention time because the

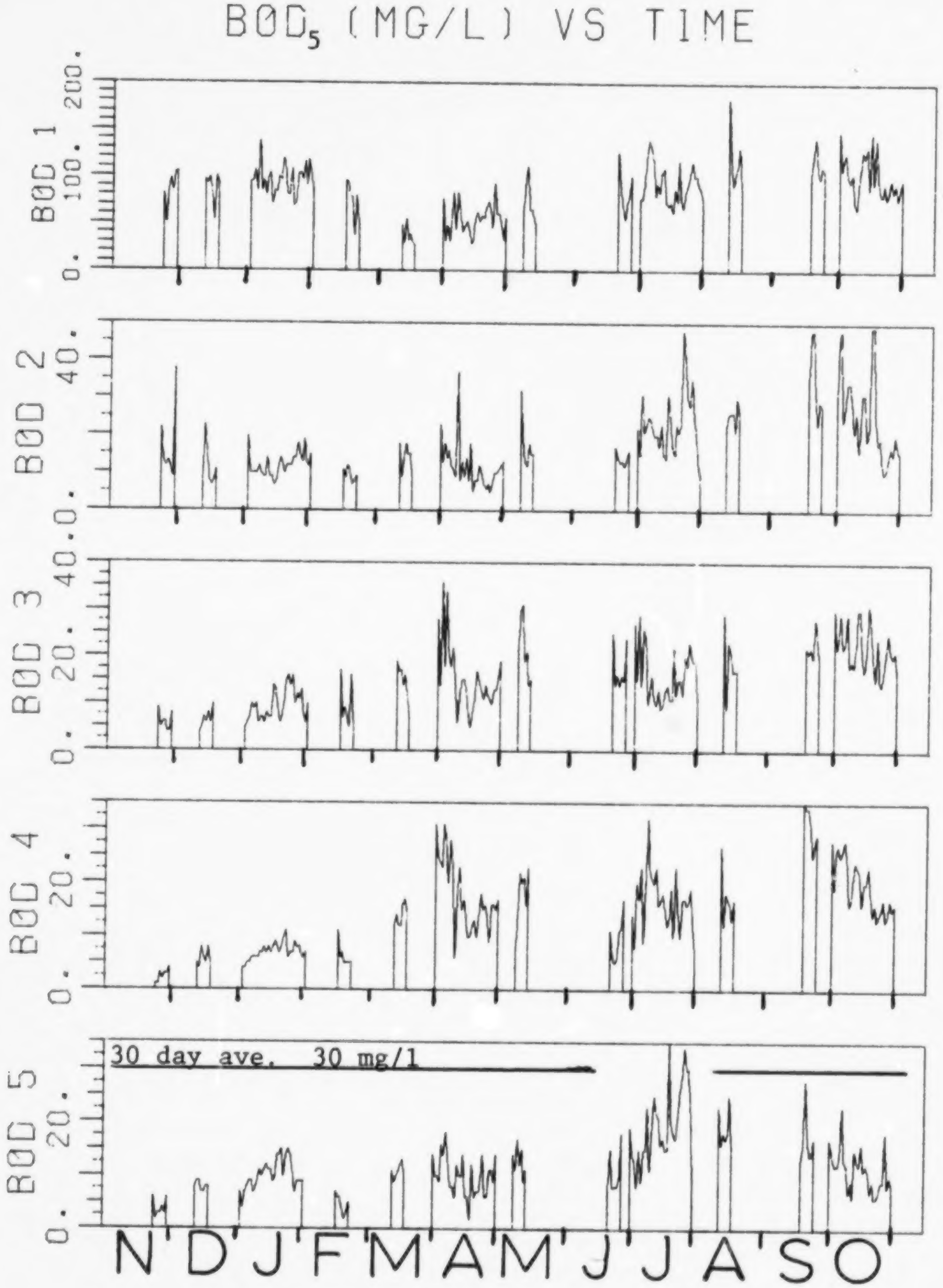


Fig. 29. BOD vs. time for all sampling points.

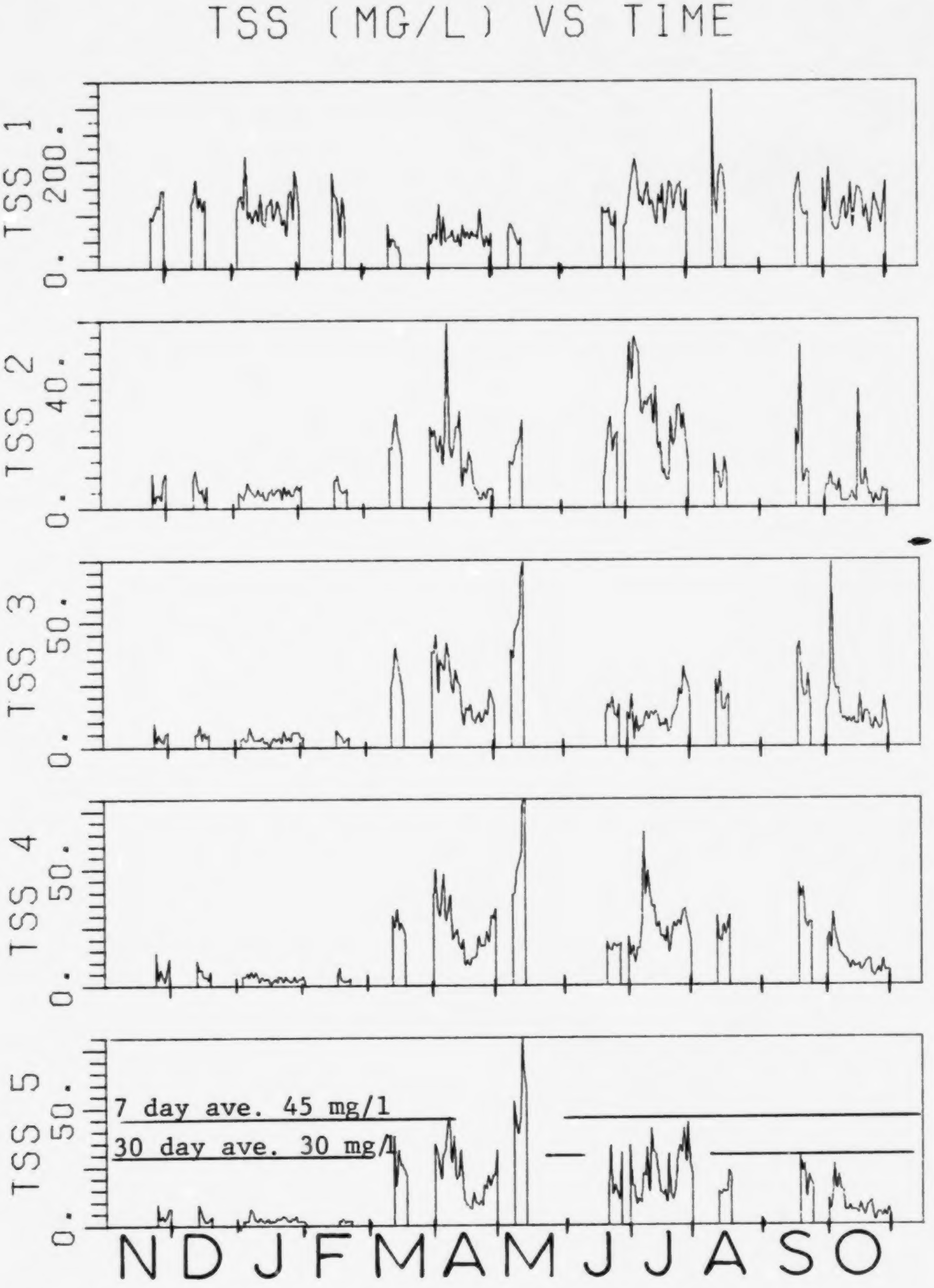


Fig. 30. TSS vs. time for all sampling points.

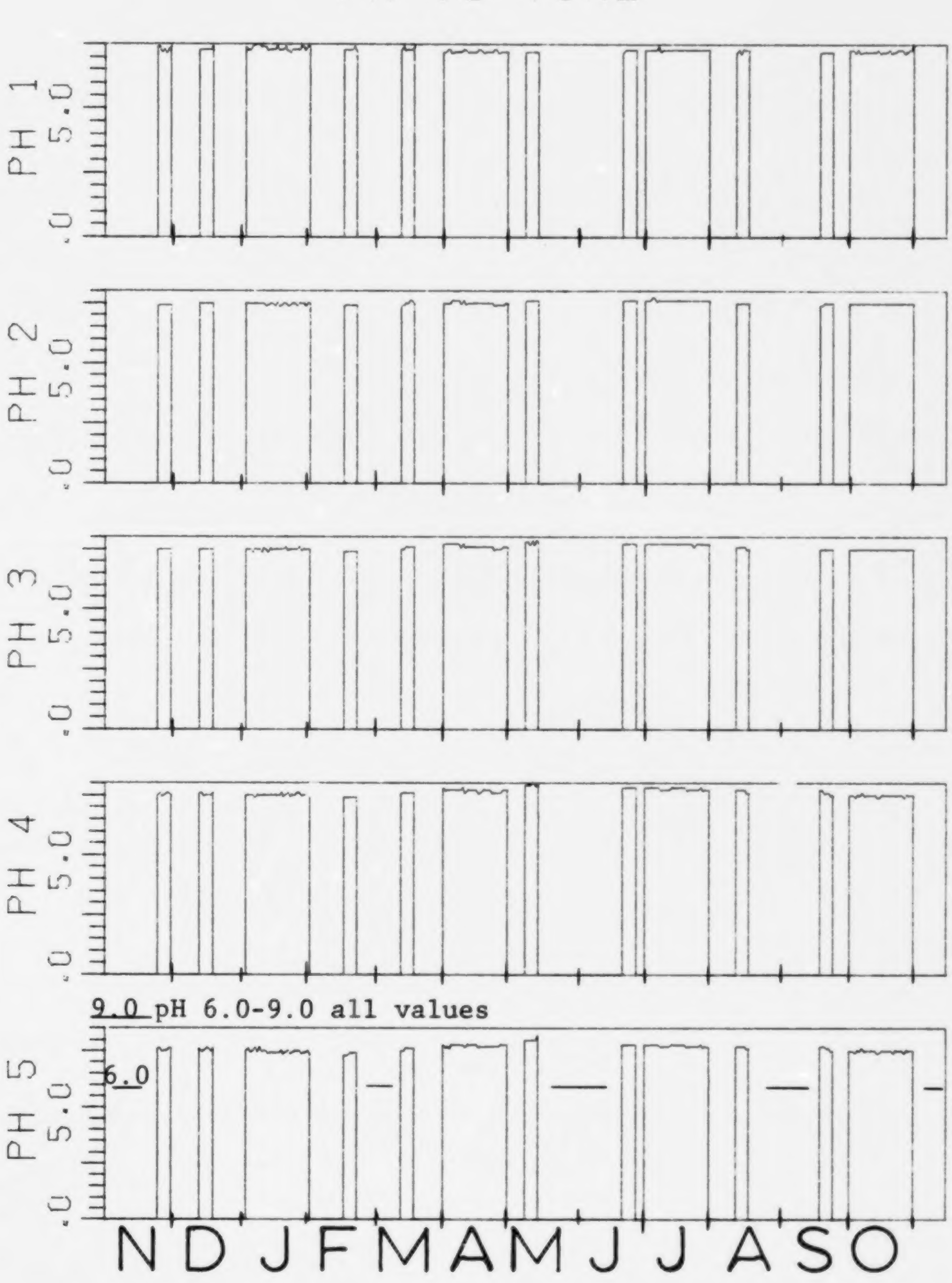


Fig. 31. pH vs. time for all sampling points.

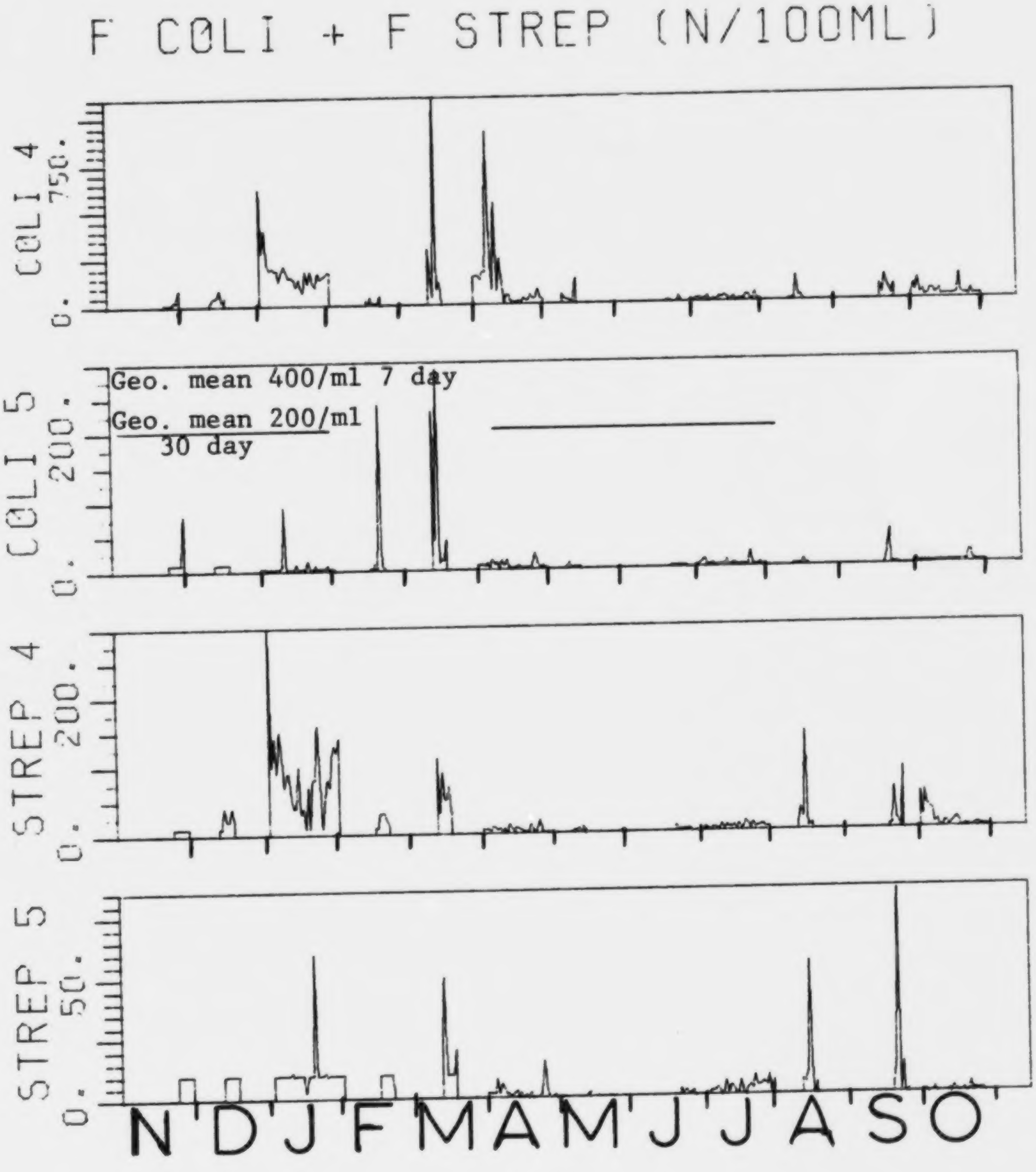


Fig. 32. Fecal Coliform and Fecal Streptococci vs. time for sampling points 4 and 5.

TABLE 9. BOD REMOVAL RELATIONSHIP FOR PRIMARY POND

Month	Influent mg/l	Effluent mg/l	Removal percent	*Detention days	k_e day^{-1}	k_{10} day^{-1}	Temperature ^oC
Nov.	87.3	17.0	80.5	48.8	0.085	0.196	6.7
Dec.	88.7	11.4	87.1	26.2	0.259	0.596	3.7
Jan.	95.9	12.1	87.4	28.9	0.240	0.552	1.4
Feb.	72.9	9.6	86.8	25.1	0.263	0.605	1.0
Mar.	37.4	14.0	62.6	18.8	0.089	0.205	4.4
Apr.	54.9	11.8	78.5	20.3	0.180	0.414	11.0
May	71.0	17.7	75.1	22.4	0.134	0.308	12.0
June	85.6	14.1	83.5	22.7	0.224	0.515	20.9
July	92.6	23.1	75.1	22.8	0.132	0.304	23.3
Aug.	117.9	25.4	78.5	22.7	0.160	0.368	22.3
Sept.	113.3	34.4	69.6	23.4	0.098	0.225	23.4
Oct.	101.6	25.1	75.3	24.2	0.126	0.290	12.0

* Detention time based on Pond No. 1 volume divided by the average influent flow rate.

pond contents are not completely mixed. Using a shorter than nominal detention time would result in higher k values. It should be noted that adequate DO levels were maintained in the Pond throughout the survey.

As part of the study, an evaluation of the mean residence time for Pond No. 1 was conducted by the use of a continuous dose of a chloride tracer. The results showed a mean pond residence time of 21.8 days for a period when the calculated residence time based on inflow and pond volume was 30.3 days. This represents a 28 percent reduction of the detention time calculated on the basis of inflow and total volume. If the detention times were reduced by 28 percent, the rate constants would increase by 39 percent or range from 0.118 to 0.366.

Intensive sampling at 1m (3 feet) depths at 18 equally spaced locations in the horizontal plane within the pond showed no significant difference between the concentration of chloride from one point to the others. If "dead" spaces were present, one may expect to find zones of lower concentrations, or if channeling was occurring, higher concentrations would likely be associated with this phenomena. In that Pond No. 1 received the greatest amount of air (61%), it is likely that Pond No. 1 had the better opportunity for establishing a mixed flow regime as compared to Pond Nos. 2 and 3 with only 25 percent and 14 percent of the air supplied, respectively.

RESULTS OF PHYSICAL AND CHEMICAL MEASUREMENTS

The results of the analyses performed are presented in their entirety in Appendix B, wherein each 7-day or 30-day sampling period for each of the sampling points is summarized by means and standard deviations in addition to the daily values. Also, the two 7-day and one 30-day sampling periods representing the four seasons are summarized by means and standard deviations. Results of the algal identifications are presented in Appendix C. Graphical representations which show the variation in the parameter measured with respect to time are shown for BOD, TSS, pH Fecal Coliform and Fecal Streptococci in Figures 29 through 32. Graphics are also presented for the remaining parameters in a similar manner in Appendix B in Figures 33 through 44. In addition, the results have been summarized in Tables 10, 11 and 12 for each 7-day and 30-day sampling period showing the percent remaining as compared to the influent during the same period for certain parameters for each of the ponds and chlorine contact tank effluents. All values presented in these tables (10, 11 and 12) represent means for the sampling periods at the various locations. The sample points numbered 1 through 5 correspond to the raw wastewater influent (1), effluent Pond No. 1 (2), effluent Pond No. 2 (3), effluent Pond No. 3 (4), and final effluent from the chlorine contact tank (5), accordingly.

Physical Measurements and D.O.

The flow to the treatment system was less than 50 percent of the design flow for all but one of the sampling periods. The highest flows were experienced during the spring runoff in March and April (Figure 34, Appendix B), which corresponded to the periods when the incoming wastewater was at its lowest strength as measured by BOD and TSS concentrations.

The temperature of the wastewater in the ponds closely paralleled the average air temperatures with the lowest pond temperatures of 1.0°C occurring during the February sampling period and the highest pond temperatures occurring in July ranging from 23.3 to 24.8°C (Figures 33 and 34, Appendix B).

The D.O. in Ponds 2 and 3 were influenced both by the saturation level of D.O. in water with respect to water temperature and by algal blooms with D.O. levels exceeding the saturation levels for the given temperature such as can be seen for the month of May in Table 10. The D.O. level in Pond No. 1 was also influenced by the water temperature saturation values and the ability of the air delivery system to transfer additional oxygen to meet the oxygen demands exerted by the incoming BOD. The organic loading to the system was low and in most instances only Pond No. 1 showed the influence of the organic loading on the resulting D.O. concentrations. The D.O. in Pond No. 1 ranged from a high of 12.8 mg/l in February (water temperature 1°C) to a low of 2.0 mg/l experienced during August (water temperature 22.3°C) (Figure 36, Appendix B).

One may conclude that when the D.O. level was above saturation for the associated water temperature that the algal populations were the contributing factor. Also, the air supply to the last two ponds during the period of blooms could be discontinued at least during the daylight hours were it not for the need for the mixing action that the air supply provides. In any event, the use of compressed air during periods of high D.O. concentrations is of marginal benefit and is wasteful of energy. At the same time the blower sizes would have to be selected so that the supply could be reduced without valving back or venting.

Alkalinity and pH

The wastewater treated in this pond system is a hard water with very high bicarbonate alkalinity. The mean values of alkalinity in the influent range from 373 to 424 mg/l with a pH of 7.2 to 7.35. Perhaps the most interesting relationship to be observed is the changes that occur in pH and alkalinity from Pond No. 1 to Pond No. 3 wherein during periods of maximum algal mass (Appendix C), April, May and June, the pH increased through

TABLE 10. MEAN RESULTS FOR EACH SAMPLING PERIOD AND EACH SAMPLING POINT FOR WATER TEMPERATURE, pH, ALKALINITY AND D.O.

Sample Period		Sample Location		Flow		Percent Design Flow	Water Temp.	Air Temp.		Alkalinity	DO
date	days			M^3/D	MGD		°C	°C	pH	mg/l	mg/l
11/24-30	7	Infl.	1	469	0.124	20.7	11.9	-5.9	7.31	424.0	---
		Pond 1	2				6.7		7.40	430.7	8.57
		Pond 2	3				6.3		7.50	417.3	11.54
		Pond 3	4				5.3		7.54	395.3	12.41
		Final E	5				5.1		7.56	398.4	12.37
12/13-19	7	Infl.	1	874	0.231	38.5	11.6	-5.0	7.31	419.0	---
		Pond 1	2				3.7		7.50	423.6	10.56
		Pond 2	3				2.7		7.50	404.0	12.69
		Pond 3	4				2.4		7.54	379.4	14.09
		Final E	5				2.4		7.56	379.0	14.09
1/3-2/1	30	Infl.	1	791	0.209	34.8	9.9	-11.4	7.35	420.3	---
		Pond 1	2				1.4		7.47	440.3	12.42
		Pond 2	3				1.2		7.50	444.6	14.14
		Pond 3	4				1.3		7.51	443.6	14.56
		Final E	5				1.2		7.46	440.7	14.56
2/16-22	7	Infl.	1	912	0.241	40.2	9.0	-2.6	7.31	384.3	---
		Pond 1	2				1.0		7.40	402.6	12.80
		Pond 2	3				1.0		7.40	392.9	14.94
		Pond 3	4				1.0		7.40	392.7	15.06
		Final E	5				1.0		7.36	399.4	15.06

(continued)

TABLE 10 (continued)

Sample Period		Sample Location		Flow		Percent Design Flow	Water Temp.	Air Temp.		Alkalinity	DO
date	days			M^3/D	MGD		°C	°C	pH	mg/l	mg/l
3/13-19	7	Infl.	1	1215	0.321	53.5	8.1	1.33	7.33	390.7	---
		Pond 1	2				4.4		7.50	393.4	11.71
		Pond 2	3				3.4		7.57	386.3	13.80
		Pond 3	4				3.1		7.60	369.7	15.01
		Final E	5				3.1		7.57	370.4	15.01
4/1-30	30	Infl.	1	1128	0.298	49.7	10.2	7.78	7.23	387.2	---
		Pond 1	2				11.0		7.50	402.5	8.53
		Pond 2	3				11.4		7.62	381.6	10.08
		Pond 3	4				11.6		7.66	344.9	10.44
		Final E	5				11.6		7.75	368.2	10.44
5/8-14	7	Infl.	1	1022	0.270	45.0	11.0	9.78	7.20	394.0	---
		Pond 1	2				12.0		7.60	402.7	10.23
		Pond 2	3				12.7		7.77	351.6	14.06
		Pond 3	4				14.0		7.93	332.7	15.33
		Final E	5				14.7		8.03	334.6	15.33
6/21-27	7	Infl.	1	1011	0.267	44.5	13.7	18.28	7.29	411.7	---
		Pond 1	2				20.9		7.60	431.6	6.29
		Pond 2	3				22.6		7.70	433.0	6.70
		Pond 3	4				22.7		7.80	402.7	7.57
		Final E	5				22.7		7.80	407.4	7.57

(continued)

TABLE 10 (concluded)

Sample Period date	Sample Period days	Sample Location	Flow M^3/D	Flow MGD	Percent Design Flow	Water Temp. °C	Air Temp. °C	Alkalinity pH	Alkalinity mg/l	DO mg/l
7/1-30	30	Infl. 1	1003	0.265	44.2	14.9	20.06	7.30	401.0	---
		Pond 1 2				23.3		7.61	438.8	4.46
		Pond 2 3				24.7		7.70	432.9	6.77
		Pond 3 4				24.8		7.75	386.2	8.02
		Final E 5				24.8		7.75	409.1	8.02
8/11-17	7	Infl 1	1007	0.266	44.3	16.0	17.28	7.27	375.1	---
		Pond 1 2				22.3		7.50	444.3	1.97
		Pond 2 3				23.3		7.57	433.7	8.29
		Pond 3 4				23.3		7.67	368.0	9.30
		Final E 5				23.3		7.67	392.3	9.30
9/18-24	7	Infl. 1	980	0.259	43.2	15.9	8.39	7.20	376.3	---
		Pond 1 2				16.4		7.47	426.9	5.60
		Pond 2 3				16.6		7.50	425.3	7.00
		Pond 3 4				16.6		7.60	384.7	8.67
		Final E 5				16.6		7.61	398.0	8.67
10/1-30	30	Infl. 1	946	0.250	41.7	14.6	3.39	7.25	373.0	---
		Pond 1 2				12.0		7.50	429.0	5.86
		Pond 2 3				11.6		7.50	419.2	7.95
		Pond 3 4				11.6		7.49	375.9	8.96
		Final E 5				11.7		7.49	397.6	8.96

the pond system and the alkalinity decreases (Figure 31 and Figure 37, Appendix B). With the present loadings on the treatment system, CO_2 would likely be produced in Pond No. 1 as a result of the bacterial utilization of the organic matter, however, the source of CO_2 for Ponds 2 and 3 appear to come from the bicarbonate alkalinity similar to that in lakes as reported by Nichols (1973). Nichols concluded that in lake waters high in nitrogen and phosphorus that the CO_2 may be the limiting factor for algal growths, but in waters of high bicarbonate alkalinity that this ion species serves as a CO_2 source with the resultant reduction in alkalinity concomitant with an increase in pH. The pH levels in Pond No. 3 effluent reached a high level of 8.0 in May during a period when maximum algal activity was evident and at a time when the minimum alkalinity was about 305 mg/l (Appendix B). The results of this survey support the concepts presented by Nichols.

Organics

The performance of the aerated pond system as it relates to BOD_5 and TSS has been discussed in an earlier portion of this section. There are some observations relative to COD, filtered COD (soluble COD) and VSS as well as some interrelationships between the various measured parameters previously discussed which may be of interest. The results are presented in Table 11 and the daily results for each sampling point plotted in Figures 29 and 30 for BOD and TSS and in Figures 38, 39 and 40, Appendix B for COD, filtered COD and VSS.

In reviewing the summary data, representing mean values for a given 7-day or 30-day test period for concentrations and percent remaining through the treatment system, several observations may be noted. The removal of organics, expressed as BOD_5 COD, TSS and VSS, occurs to a great extent in Pond No. 1 with only small improvement in removals noted for Pond Nos. 2 and 3. This is related to the fact that the treatment system was underloaded relative to the design as noted previously.

The pond system performed quite well for the first 4 months (winter) of the survey program through February, thereafter several factors influenced the poorer performance. In March, the removal percentages were considerably lower partially due to the lower strength of influent, but a major factor was the effect of higher water temperatures which brought about the accelerated decomposition of deposits in the ponds which accumulated during the winter months. The suspended and volatile suspended solids concentrations in the pond effluents increased considerably and had some effect on the other measured parameters of BOD and COD but to a less significant degree. The high levels of solids continued through May when the major increases were associated with the increase in algal populations in April and May. Thereafter, a marked improvement in solids concentra-

TABLE 11. MEAN RESULTS AND PERFORMANCE FOR EACH SAMPLING PERIOD AND EACH SAMPLING POINT FOR BOD_5, COD, FILTERED COD, TSS AND VSS

Sample Period		Sample Location	BOD_5		COD		Filtered COD		TSS		VSS	
date	days		mg/l	% Remain	mg/l	% Remain	mg/l	% Remain	mg/l	% Remain	mg/l	% Remain
11/24-30	7	Infl. 1	87.3	----	168.1	----	37.9	----	116.1	----	95.3	----
		Pond 1 2	17.0	19.5	32.4	19.3	26.9	71.0	6.3	5.4	4.6	4.8
		Pond 2 3	6.0	6.9	25.3	15.1	16.9	44.6	4.7	4.0	3.3	3.4
		Pond 3 4	2.4	2.7	20.6	12.3	15.9	42.0	7.0	6.0	4.3	4.5
		Final E 5	3.9	4.5	21.6	12.8	15.7	41.4	5.3	4.6	4.4	4.6
12/13-19	7	Infl. 1	88.7	----	208.9	----	34.0	----	129.0	----	103.9	----
		Pond 1 2	11.4	12.9	33.9	16.2	22.1	65.0	6.9	5.3	5.7	5.5
		Pond 2 3	6.6	7.4	23.1	11.1	18.6	54.7	5.3	4.1	4.1	3.9
		Pond 3 4	5.9	6.7	20.9	10.0	15.7	46.2	6.0	4.7	4.7	4.5
		Final E 5	8.0	9.0	25.0	12.0	16.6	48.8	4.4	3.4	4.0	3.8
1/3-2/1	30	Infl. 1	95.9	----	228.1	----	45.6	----	114.9	----	92.8	----
		Pond 1 2	12.1	12.6	51.2	22.4	44.2	96.9	5.0	4.4	4.4	4.7
		Pond 2 3	9.5	9.9	42.2	18.5	37.8	82.9	3.8	3.3	3.1	3.3
		Pond 3 4	7.1	7.4	39.9	17.5	35.5	77.9	3.3	2.9	2.9	3.1
		Final E 5	10.1	10.5	40.9	17.9	36.8	80.7	2.8	2.4	2.5	2.7
2/16-22	7	Infl. 1	72.9	----	251.6	----	42.3	----	123.0	----	83.3	----
		Pond 1 2	9.6	13.2	45.6	18.1	35.6	84.2	7.1	5.8	5.6	6.7
		Pond 2 3	9.7	13.3	38.3	15.2	30.6	72.3	4.4	3.6	2.4	2.9
		Pond 3 4	6.3	8.6	31.7	12.6	28.6	67.6	3.4	2.8	2.0	2.4
		Final E 5	4.7	6.4	30.3	12.0	28.1	66.4	2.1	1.7	1.6	1.9
3/13-19	7	Infl. 1	37.4	----	115.7	----	29.0	----	47.9	----	35.7	----
		Pond 1 2	14.0	37.4	52.3	45.2	30.1	103.8	22.0	45.9	20.1	56.3
		Pond 2 3	14.6	39.0	54.0	46.7	32.4	111.7	28.9	60.3	18.9	52.9
		Pond 3 4	14.0	37.4	52.3	45.2	29.0	100.0	26.6	55.5	20.0	56.0
		Final E 5	10.9	29.1	52.3	45.2	34.7	119.7	26.3	54.9	16.7	46.8
4/1-30	30	Infl. 1	54.9	----	126.6	----	30.9	----	63.5	----	50.6	----
		Pond 1 2	11.8	21.5	48.4	38.2	28.0	90.6	16.2	25.5	15.0	29.6
		Pond 2 3	15.5	28.2	50.1	39.6	27.9	90.3	22.7	35.7	16.5	32.6
		Pond 3 4	17.7	32.2	56.9	44.9	24.5	79.3	24.2	38.1	20.2	39.9
		Final E 5	10.0	18.2	53.2	42.0	30.8	99.7	21.8	34.3	18.2	36.0

(continued)

TABLE 11 (concluded)

Sample Period date	days	Sample Location	BOD$_5$ mg/l	BOD$_5$ % Remain	COD mg/l	COD % Remain	Filtered COD mg/l	Filtered COD % Remain	TSS mg/l	TSS % Remain	VSS mg/l	VSS % Remain
5/8-14	7	Infl. 1	71.0	----	160.4	----	26.0	----	63.6	----	52.1	----
		Pond 1 2	17.7	24.9	54.1	33.7	24.1	92.7	19.3	30.3	18.1	34.7
		Pond 2 3	21.4	30.1	88.7	55.3	24.4	93.8	52.4	82.4	38.0	72.9
		Pond 3 4	17.4	24.5	79.9	49.8	21.0	80.8	57.0	89.6	37.3	71.6
		Final E 5	12.7	17.9	74.3	46.3	29.9	115.0	55.0	86.5	31.0	59.5
6/21-27	7	Infl. 1	85.6	----	186.1	----	36.9	----	99.9	----	81.7	----
		Pond 1 2	14.1	16.5	55.9	30.0	29.3	79.4	20.4	20.4	18.7	22.9
		Pond 2 3	17.7	20.7	46.0	24.7	27.3	74.0	15.4	15.4	10.3	12.6
		Pond 3 4	9.7	11.3	43.1	23.2	22.3	60.4	17.1	17.1	12.4	15.2
		Final E 5	10.7	12.5	41.1	22.1	26.9	72.9	19.0	19.0	12.4	15.2
7/1-30	30	Infl. 1	92.6	----	228.9	----	34.0	----	132.6	----	100.3	----
		Pond 1 2	23.1	24.9	74.1	32.4	36.0	105.9	29.8	22.5	27.1	27.0
		Pond 2 3	16.1	17.4	55.5	24.2	35.7	105.0	13.9	10.5	10.9	10.9
		Pond 3 4	16.8	18.1	64.0	28.0	32.5	95.6	26.7	20.1	20.6	20.5
		Final E 5	19.5	21.1	60.3	26.3	38.2	112.4	22.9	17.3	16.1	16.1
8/11-17	7	Infl. 1	117.9	----	299.3	----	17.9	----	183.0	----	131.1	----
		Pond 1 2	25.4	21.5	44.0	14.7	24.7	138.0	11.6	6.3	10.0	7.6
		Pond 2 3	19.0	16.1	44.1	14.7	22.9	127.9	21.1	11.5	16.1	12.3
		Pond 3 4	17.1	14.5	43.6	14.6	18.3	102.2	24.7	13.5	20.0	15.3
		Final E 5	19.0	16.1	38.3	12.8	19.1	106.7	16.1	8.9	12.7	9.7
9/18-24	7	Infl. 1	113.3	----	194.0	----	20.6	----	126.4	----	93.3	----
		Pond 1 2	34.4	30.4	48.0	24.7	26.1	126.7	19.7	15.6	13.4	14.4
		Pond 2 3	22.6	19.9	44.7	23.0	17.3	84.0	27.9	22.1	14.4	15.4
		Pond 3 4	30.7	27.1	47.4	24.4	17.7	85.9	32.9	26.0	23.0	24.7
		Final E 5	17.0	15.0	41.6	21.4	21.7	105.3	21.0	16.6	13.9	14.9
10/1-30	30	Infl. 1	101.6	----	199.9	----	18.4	----	114.0	----	87.5	----
		Pond 1 2	25.1	24.7	35.7	17.9	20.7	112.5	6.1	5.4	4.9	5.6
		Pond 2 3	22.0	21.7	39.9	20.0	20.0	108.7	15.3	13.4	9.6	11.0
		Pond 3 4	19.6	19.3	32.3	16.2	17.9	97.3	11.1	9.7	7.1	8.1
		Final E 5	11.3	11.1	31.3	15.7	16.9	91.8	8.3	7.3	6.0	6.9

tions and percent removals associated therewith occurred. The COD values were the highest during the May survey period and the highest values were found in the effluents from Pond Nos. 2 and 3 where the algal blooms were most pronounced. The highest filtered COD occurred in July with generally higher filtered CODs in the pond effluents and in the wastewater influent to the system in July and August. Essentially no removal of filtered COD occurred through the treatment system through September and October. It would appear that filtered COD would have limited value relative to pond performance in that significant removals of BOD were accomplished during the same period.

Using the results from the survey, several relationships were calculated for the wastewater influent (sample point 1) and Pond No. 3 effluent (sample point 4) which were of some interest. As one would expect, the COD to BOD_5 ratio for the influent was lower 2.32 than for the effluent with a value of 3.23. The volatile solids in the effluent contribute less to the BOD_5 than the volatile solids in the influent in that the effluent volatile solids are made up of refractory soluble organics and volatile suspended solids such as bacterial floc and/or algae all of which contribute less BOD_5 per unit mass than the raw wastewater volatile solids. By subtracting the filtered COD from the total COD and correlating the difference with the volatile suspended solids revealed that a ratio of COD:VSS in the influent was 1.98 whereas the ratio COD:VSS in the effluent was 1.45. This indicates that the higher COD:BOD_5 ratio in the effluent is not the result of readily oxidized (chemical) volatile solids in the effluent. The organic matter present in the effluent does not contribute as much to the COD per unit mass as in the wastewater influent. The correlation coefficient for the 12 values of COD-filtered COD vs. VSS in the effluent was 0.979.

The ratio of filtered COD:BOD_5 of the influent was 0.37, whereas the filtered COD:BOD_5 ratio for Pond No. 3 effluent was 1.7. The relatively low ratio in the influent is likely related to the large proportion of BOD_5 exerted by the volatile suspended solids not measured by the filtered COD test, whereas the BOD_5 in the effluent can be considered to be more nearly related to the remaining soluble organic fraction. If filtered BOD measurements were made of the influent and effluents, a more definitive relationship between dissolved and suspended BOD and COD could be made. It is important to make the distinction of the basic differences between influent and effluent suspended solids but more importantly the effect of the residual phytoplankton populations in the final effluent on the receiving environment. The volatile solids fraction in the influent suspended solids was 0.767 as compared to 0.727 in the effluent suspended solids which for all practical purposes is not significantly different.

Nutrients

The results of the nitrogen and phosphorus determinations have been summarized in Table 12 and presented graphically on a day-to-day basis in Figures 41 through 44 in Appendix B. Calculations for percent remaining as related to the influent is presented for TKN, ammonia nitrogen and total phosphorus, whereas for nitrite nitrogen and nitrate nitrogen, mean concentration values for the various sampling points are presented. Limited value should be given to the idea of nitrogen removal because of the conversions of nitrogen from organic to inorganic to organic and combinations thereof in addition to possible interchanges with the atmosphere.

Several interesting results were obtained where the ammonia nitrogen concentration in the effluent from Pond No. 1 was higher than the influent levels in all 12 of the test periods (Table 12) with values up to 300 percent higher than in the influent (October). This is attributed to the fact that although the pond contents were mixed by the introduction of air, the level of turbulence is not sufficient to prevent the deposition of solids on the pond bottom and thereafter be subjected to anaerobic fermentation in the accumulated deposits. The net effect is the deamination of organic matter with the resultant increase in ammonia nitrogen levels. The ammonia nitrogen levels in Pond No. 3 effluent were generally higher during the colder months than during the warmer periods. This is attributed in part to the conversion of ammonia nitrogen to nitrite and nitrate nitrogen as well as the assimilation of the nitrogen into organic nitrogen as part of the living organisms. By subtracting the ammonia nitrogen from total Kjeldahl nitrogen, the difference represents organic nitrogen. Generally the levels of organic nitrogen in the effluent from Pond No. 3 was higher during the warmer periods May through September as compared to the remaining colder months. The higher organic nitrogen levels can be related to the higher concentrations of phytoplankton and biological solids during the warmer months. The nitrate nitrogen levels dropped in the effluent from the chlorine contact tank from the levels in Pond No. 3 effluent in 10 of the 12 report periods. The nitrite nitrogen levels were slightly higher during the warmer months than during the colder months.

The total phosphorus levels in the effluent of Pond No. 1 were essentially the same as the influent wastewater as was the effluent from Pond No. 3. In that phosphorus is a conservative substance, a mass balance was made wherein the concentrations were multiplied by the influent flow and the days per month to arrive at annual amounts for the raw wastewater influent, Pond No. 1 effluent and Pond No. 3 effluent of 1996 kg (4401 lbs.), 1962 kg (4235 lbs.) and 2003 kg (4417 lbs.), respectively, indicating no reduction in total phosphorus. If reductions do occur, it can only be attributed to the solids retained in the

TABLE 12. MEAN RESULTS AND PERFORMANCE FOR EACH SAMPLING PERIOD AND EACH SAMPLING POINT FOR TKN, NH_3-N, TOTAL P, NO_2-N, AND NO_3-N

Sample Period		Sample Location	TKN		NH_3-N		NO_2-N	NO_3-N	Total P	
date	days		mg/l	% Remain	mg/l	% Remain	mg/l	mg/l	mg/l	% Remain
11/24-30	7	Infl. 1	20.8	----	15.1	----	0.07	0.51	9.1	----
		Pond 1 2	18.3	88.0	16.4	108.6	0.10	0.27	6.7	73.4
		Pond 2 3	13.2	63.5	11.7	77.5	0.14	3.26	7.1	77.9
		Pond 3 4	8.6	41.3	7.5	49.7	0.17	3.86	5.7	63.3
		Final E 5	8.6	41.3	7.4	49.0	0.16	3.94	6.8	75.4
12/13-1[illegible]	7	Infl. 1	17.9	----	13.7	----	0.03	1.31	4.9	----
		Pond 1 2	17.2	96.1	16.0	116.8	0.06	0.44	6.6	134.5
		Pond 2 3	14.0	78.2	12.8	93.4	0.04	2.50	9.9	202.7
		Pond 3 4	10.2	57.0	9.2	67.2	0.03	3.39	8.9	182.2
		Final E 5	10.4	58.1	9.0	65.7	0.14	3.40	6.2	125.9
1/3-2/1	30	Infl. 1	21.3	----	16.1	----	0.03	0.18	8.5	----
		Pond 1 2	18.1	85.0	16.4	101.9	0.41	1.95	8.4	98.5
		Pond 2 3	14.7	69.0	13.7	85.1	0.07	3.85	9.2	107.8
		Pond 3 4	13.4	62.9	12.1	75.2	0.06	3.68	9.1	107.1
		Final E 5	15.2	71.4	13.2	82.0	0.08	2.69	8.0	93.5
2/16-22	7	Infl. 1	17.6	----	12.5	----	0.02	0.37	5.0	----
		Pond 1 2	19.1	108.5	17.1	136.8	0.07	0.51	6.1	120.7
		Pond 2 3	13.9	79.0	10.6	84.8	0.08	6.26	4.6	92.0
		Pond 3 4	14.9	84.7	12.4	99.2	0.04	3.80	4.8	96.2
		Final E 5	16.4	93.2	14.8	118.4	0.06	1.50	6.0	119.5

(continued)

TABLE 12 (continued)

Sample Period		Sample Location	TKN		NH_3-N		NO_2-N	NO_3-N	Total P	
date	days		mg/1	% Remain	mg/1	% Remain	mg/1	mg/1	mg/1	% Remain
3/13-19	7	Infl. 1	6.4	----	4.7	----	0.14	3.43	3.4	----
		Pond 1 2	7.3	114.1	6.4	136.2	0.08	5.46	3.9	113.5
		Pond 2 3	6.8	106.2	5.4	114.9	0.18	7.33	4.6	135.3
		Pond 3 4	5.2	81.2	3.6	76.6	0.11	9.13	5.3	157.1
		Final E 5	13.9	217.2	11.5	244.7	0.16	1.10	5.3	155.9
4/1-30	30	Infl. 1	11.3	----	7.7	----	0.11	1.11	6.9	----
		Pond 1 2	10.3	91.2	8.3	107.8	0.22	0.99	6.5	94.1
		Pond 2 3	7.1	62.8	5.1	66.2	0.36	2.15	6.3	90.9
		Pond 3 4	3.4	30.1	1.6	20.8	0.26	4.35	6.9	99.3
		Final E 5	7.3	64.6	4.5	58.4	0.31	1.52	6.4	93.2
5/8-14	7	Infl. 1	12.3	----	7.6	----	0.05	1.27	5.1	----
		Pond 1 2	11.9	96.7	7.8	102.6	0.27	1.33	5.5	106.2
		Pond 2 3	7.7	62.6	2.9	38.2	0.49	2.40	4.9	94.6
		Pond 3 4	5.1	41.5	0.7	9.2	0.20	2.31	5.7	111.1
		Final E 5	5.7	46.3	0.7	9.2	0.35	1.79	3.7	72.2
6/21-27	7	Infl. 1	17.1	----	12.0	----	0.07	0.30	9.4	----
		Pond 1 2	18.9	110.5	15.7	130.8	0.33	0.69	6.7	70.7
		Pond 2 3	13.0	76.0	10.5	87.5	0.70	1.10	8.4	88.6
		Pond 3 4	7.5	43.9	5.1	42.5	0.54	1.14	6.9	72.7
		Final E 5	7.6	44.4	4.6	38.3	0.38	0.81	6.1	64.5

(continued)

TABLE 12 (concluded)

Sample Period		Sample Location	TKN		NH_3-N		NO_2-N	NO_3-N	Total P	
date	days		mg/l	% Remain	mg/l	% Remain	mg/l	mg/l	mg/l	% Remain
7/1-30	30	Infl. 1	18.1	----	11.8	----	0.12	1.53	6.1	----
		Pond 1 2	18.7	103.3	14.4	122.0	0.49	1.60	6.3	104.1
		Pond 2 3	14.1	77.9	11.0	93.2	0.79	2.15	7.1	116.1
		Pond 3 4	5.9	32.6	2.5	21.2	0.83	3.97	5.9	97.4
		Final E 5	7.6	42.0	4.3	36.4	1.78	2.18	4.6	75.9
8/11-17	7	Infl. 1	15.0	----	7.0	----	0.17	1.93	4.8	----
		Pond 1 2	21.2	141.3	17.1	244.3	0.31	2.09	4.7	99.2
		Pond 2 3	14.6	97.3	10.8	154.3	0.70	2.29	4.6	97.3
		Pond 3 4	4.7	31.3	1.4	20.0	1.05	5.57	3.1	65.8
		Final E 5	6.0	40.0	2.9	41.4	1.75	3.14	3.0	63.5
9/18-24	7	Infl. 1	15.7	----	7.3	----	0.04	2.26	4.2	----
		Pond 1 2	19.1	121.7	15.4	211.0	0.10	1.89	4.3	103.1
		Pond 2 3	16.1	102.5	12.8	175.3	0.17	1.33	4.8	113.3
		Pond 3 4	8.2	52.2	4.9	67.1	0.61	3.50	3.6	85.5
		Final E 5	8.4	53.5	5.1	69.9	0.88	2.84	3.6	85.3
10/1-30	30	Infl. 1	9.8	----	4.4	----	0.05	5.78	4.3	----
		Pond 1 2	16.1	164.3	13.1	297.7	0.19	3.23	4.0	92.6
		Pond 2 3	14.0	142.9	11.1	252.3	0.42	3.18	4.0	92.1
		Pond 3 4	5.5	56.1	3.4	77.3	0.44	6.36	4.0	93.1
		Final E 5	8.5	86.7	5.9	134.1	0.64	3.22	4.0	92.8

pond system. In this instance for the period of study, no reduction of phosphorus occurred in the treatment.

ALGAL IDENTIFICATION

The algal populations of the ponds were determined as to species and numbers throughout the survey period. The results of the determinations are presented in Appendix C for the various sampling periods and for the three ponds. The results are presented as cells per ml with the exception of the species of Pediastrum and Scenedesmus which are expressed in colonies per ml.

During the first phase of the study, November 75 through February 76, Ponds 1 and 2 had no significant amounts of algae until the February 16 sampling date at which time some Chlamydomonas sp. could be detected in 20x concentrations of Pond No. 2. Pond No. 3 had a variety of diatoms and Chlamydomonas sp. during this period but the concentration levels present were so low as to not be measured as total suspended solids.

In the period March through May, Pond No. 1 had only the green Chlorella sp. present until the last sample of April (4/23) when Chlamydomonas and Gonium sp. appeared. Pond No. 2 also had only the Chlorella sp. present early in this period but the diatom Nitzschia sp. appeared by April 9 and there was a large variety of algae present by April 23 (Chlorella, Scenedesmus, Pediastrum and Nitzchia). Additional varieties were found in May of Protococcus, Navicula and Microactinium sp. Pond No. 3 had a varied flora throughout this period. During the period of maximum bloom of algae in all ponds (May samples), a variety of species appeared: Chlorella, Scenedesmus, Microactinium, Protococcus, Euglena and Navicula.

During the mid-summer period, June through August, a light bloom of a mixture of algae appeared in all ponds. The green algae, Coelestrum sp., Oocystis and Closterium sp. as well as the blue-green Microcystis sp. were among the varieties that appeared during this period. The blue-green alga was readily visible in the pond and in samples because of its buoyancy; however, it did not make up the majority of the total suspended solids present.

The fall period, represented by September and October, experienced a varied population of green algae and the blue-green Microcystis sp. with the exception of Pond No. 1 which only had Chlamydomonas sp. in the September 21 sample and essentially nothing after that. The algae in the other ponds also decreased in October until there were essentially none present on the October 21 samples.

In general, when the greatest mass of algae was present in the ponds, it was made up of a mixture of algae much the same as was reported from earlier pond studies in Wisconsin (Kaneshige, et al. 1957 and Fitzgerald, 1960) and in California (Silva and Papenfuss, 1953). The variety of algae found in the final effluent samples representing Pond No. 3 was similar to the variety found by sampling in the pond including Microcystis sp. which has a tendency to float.

ALGAL ASSAY OF ROCK RIVER AND KOSHKONONG POND NO. 3 EFFLUENT

The purpose of the algal assay was to determine what nutrient limits the growth of algae in the Rock River near the point of discharge of the effluent from the aerated pond treatment system to assess the potential effect of the pond effluent on the growth of algae in the Rock River. The test organism was the green alga selected by EPA for such bioassays, Selenestrum capricornutum (AAP). Three media were used for the algal assay: 1) Gorham's medium, 2) Pond No. 3 effluent 11/3/76, TSS = 5 mg/l, 3) Rock River water collected at Highway Wisconsin 59, TSS = 48 mg/l. The media, after autoclaving, were innoculated with 1000 Selenestrum/ml from a pond effluent culture and harvested after 14 days incubation of triplicate cultures. Aminco Fluorometric readings and calculated concentrations of chlorophyll a in mg/l were the response variables. The three nutrients P, N and Fe which have been shown to limit the growth of algae in midwestern lake waters were varied with the three cultures and mixtures thereof.

Table 13 shows the culture medium conditions and the response after the 14-day incubation period. Control cultures using Gorham's medium were used to demonstrate that the inoculum of Selenestrum capricornutum (AAP) would not grow in the medium lacking P, N or Fe. The tests indicated that less than 1 percent of the growth in the complete Gorham medium was obtained in cultures lacking P, N or Fe indicating that the inoculum used in the test was sensitive to these nutrients.

When P, N or Fe were added to samples of the pond effluent, there was no stimulation of growth over the growth in the pond effluent alone. Therefore a combination of these nutrients was probably limiting the growth and from the initial stimulation caused by spikes of iron followed by a loss of green color indicated that iron and then nitrogen were probably the limiting factors for the pond effluent. The algal cells of the pond cultures also had the exaggerated twisting "ram's horns" configuration to be expected in nitrogen deficient cultures of Selenestrum.

TABLE 13. ALGAL ASSAY RESULTS

Medium	Aminco Fluorometer Ave. Reading	Calculated Chlorophyll *a* mg/1
Controls		
1. Gorham's Medium	430	19
2. Gorham's Medium (-P)	0.15	0.007
3. Gorham's Medium + 10% Gorham P	420	19
4. Gorham's (-N)	1.5	0.07
5. Gorham's Medium + 10% Gorham N	110	5.0
6. Gorham's (-Fe)	1.6	0.072
7. Gorham's Medium + 10% Gorham Fe	440	20
Pond No. 3 Effluent		
1. Pond only	34	1.5
2. Pond + 10% Gorham P	26	1.2
3. Pond + 10% Gorham N	32	1.4
4. Pond + 10% Gorham Fe	29	1.3
Rock River Samples		
1. River only	3.1	0.14
2. River + 2 mg/1 NO_3-N	10	0.45
3. River + 8 mg/1 NO_3-N	14	0.63
4. River + 0.18 mg/1 PO_4-P	3.6	0.16
5. River + 0.72 mg/1 PO_4-P	2.6	0.12
6. River + 0.025 mg/1 Fe	3.3	0.15
7. River + 0.10 mg/1 Fe	2.9	0.13
8. River + 0.25 % Pond	3.0	0.14
9. River + 0.50 % Pond	3.7	0.17
10. River + 1.0% Pond	4.9	0.22
11. River + 2.5% Pond	4.3	0.19
12. River + 5.0% Pond	4.7	0.21
13. River only	3.1	0.14

The algae growing in samples of Rock River water were found to be stimulated by the addition of nitrogen but not by the addition of phosphorus or iron. There was a slight stimulation due to the addition of the pond effluent, but the amount of effluent 0.5 percent or more was required to bring about a stimulation which was far in excess of the percentage of effluent that enters the Rock River.

More detailed studies could have been conducted to further assess the nutrients limiting the growth of algae in the Rock River at that time of the year (November), but this fertile river had sufficient nutrients already present such that the addition of 0.5 percent or more of its flow would have to come from the Koshkonong ponds before any effect would be made on algal growth in the river.

During Feburary of 1976 when there was little algal activity in the ponds, comparisons of analyses of the Rock River and the pond effluent were made to determine the influence that the pond effluent may have on the river during a period of supposedly lowest effectiveness of the pond system. Samples were compared for February 16, 18 and 20.

The BOD of the Rock River (3-5 mg/l) was in the same range as Pond No. 3 effluent (2-7 mg/l), but the COD of the pond effluent samples (25-40 mg/l) were slightly lower than the Rock River (29-48 mg/l) whether comparing unfiltered or filtered samples. During this period of low algal activity in the ponds, the total and volatile suspended solids (2-3 mg/l) were much less than the Rock River (20-53 mg/l).

A detailed analysis of the plankton of the Rock River was not made but there was a remarkable similarity between the dominant species recorded for the river (Mackenthum, et al., 1960) and what was found in the ponds. At times, diatoms were predominant and the green algae Coelestrum, Closterium and Scenedesmus were found to be frequent in both the river and the pond.

SECTION 7

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APPENDIX A

EVALUATION OF POND SAMPLING USING CHLOROPHYLL a

I. Sampling Evaluation No. 1 5/27/76

A. Replicate Pond Samples (Pond Surface)

Measurements made on acetone extracts with Aminco Fluorometer, 665μ were 1 fluorometer unit = 0.045 mg chlorophyll a/1

Fluorometric Units

Pond No. 1		Pond No. 2		Pond No. 3	
1. 0.95	6. 1.10	11. 3.9	16. 5.2	21. 0.58	26. 0.52
2. 0.94	7. 0.90	12. 4.7	17. 5.1	22. 0.58	27. 0.62
3. 0.92	8. 0.92	13. 4.6	18. 4.9	23. 0.56	28. 0.48
4. 1.10	9. 0.90	14. 4.8	19. 5.1	24. 0.72	29. 0.48
5. 1.05	10. 0.80	15. 4.6	20. 5.2	25. 0.50	30. 0.47
mean = 0.96		mean = 4.8		mean = 0.55	
s = 0.096		s = 0.40		s = 0.078	

B. Effluent Samples from Pond No. 3. (Sample from mid-depth)

Fluorometric Units

Pond No. 3			
1. 0.55	6. 0.48		
2. 0.58	7. 0.50		
3. 0.51	8. 0.49		
4. 0.52	9. 0.49		Pond No. 3 Surface (see A)
5. 0.52	10. 0.55		
mean = 0.52		vs.	mean = 0.55
s = 0.032			s = 0.078

C. Replicates Analyses of a Single Sample from Pond No. 2 Surface

Fluorometric Units

1.	4.9	6.	4.7
2.	4.9	7.	4.8
3.	4.8	8.	4.7
4.	4.7	9.	4.7
5.	4.8	10.	4.7

mean = 4.8
s = 0.082

D. Conversion Factors

1. One fluorometer unit = 0.045 mg chlorophyll a/1 based on triplicate analyses of optical density at 665 (1 cm) with Aminco Fluorometer on acetone extracts.

2. Non-filterable residue dry weights (surface samples).

Pond	Sample Volume, ml	Net Weight mg	Concentration mg/1	
1	150	2.1	14.0	
1	150	1.8	12.0	mean = 13.6 mg/1
1	150	2.0	13.3	s = 1.4
1	150	2.3	15.3	
2	100	4.1	41.	
2	100	4.4	44.	mean = 43 mg/1
2	100	4.4	44.	s = 1.4
2	100	4.3	43.	
3	200	1.5	7.5	
3	200	1.1	5.5	mean = 7.0
3	200	1.6	8.0	s = 1.08
3	200	1.4	7.0	

3. Algal cell counts/ml

	Count 1	Count 2	Count 3
Pond No. 1			
Protococcus sp.	16,000	26,000	32,000
Pond No. 2			
Scenedesmus sp.	3,240,000	2,960,000	3,760,000
Pond No. 3			
Protococcus sp.	48,000	24,000	48,000

4. Summary

Pond No. 2: 3×10^6 cells/ml = 43 mg wt./l =
0.22 mg chlorophyll a/l
1 Aminco fluor. unit = 9.0 mg TSS
Pond No. 1: 1 Aminco fluor. unit = 14.2 mg TSS
Pond No. 3: 1 Aminco fluor. unit = 1.27 mg TSS

II. Sampling Evaluation No. 2 9/28/76 (Light surface bloom of *Microcystis* in Pond No. 3)

	Aminco Fluorometer Readings					Total Suspended Solids mg/l	
	Pond No. 1 Surface	Pond No. 2 Surface	Pond No. 3 Surface	Pond No. 3 Effluent		Pond No. 3 Surface	Pond No. 3 Effluent
1.	0.28	1.1	1.1	0.7	1.	17	9
2.	0.28	1.0	1.1	0.6	2.	17	11
3.	0.28	1.2	1.0	0.7	3.	14	10
4.	0.27	1.3	1.1	0.7	4.	14	11
5.	0.29	1.1	1.2	0.6	5.	17	9
6.	0.27	1.0	1.1	0.7	6.	15	13
7.	0.28	1.2	1.0	0.7			
8.	0.28	1.2	1.1	0.6			
9.	0.27	1.1	1.0	0.7			
10.	0.27	1.3	1.2	0.7			
Range	0.27-0.29	1.0-1.3	1.0-1.2	0.6-0.7		14-17	9-13
Mean	0.28	1.15	1.09	0.67		15.7	10.5
s	0.007	0.11	0.074	0.048		1.5	1.5

Ratios: 1.09 Fluorometer units = 15.7 mg TSS/l Pond No. 3 Surface
or 14.4 mg TSS/l per one fluorometric unit

0.67 Fluorometer units = 10.5 mg TSS/l Pond No. 3 Effluent
or 15.7 mg TSS/l per one fluorometric unit

0.045 mg chlorophyll a/l = one fluorometric unit.

APPENDIX B

SUMMARY OF DAILY ANALYSES FOR MEASURED PARAMETERS

Nomenclature

Sea mean = seasonal mean
Sea Std Dev = seasonal standard deviation
( ) = estimated value
< = less than stated amount

Sampling points, Nos. 1-5

No. 1. Influent to Pond No. 1
No. 2. Effluent from Pond No. 1
No. 3. Effluent from Pond No. 2
No. 4. Effluent from Pond No. 3
No. 5. Effluent from chlorine contact tank

Air temperature °C = (°F-32) 5/9
1 MGD = 3785 m^3/d
pH = $-\log[H^+]$
mg/l = milligrams per liter
ml = milliliter
Alkalinity = expressed as mg/l $CaCO_3$
TKN = total Kjeldahl nitrogen
TSS = total suspended solids
VSS = volatile suspended solids
BOD_5 = 5 day, 20°C biochemical oxygen demand
COD = chemical oxygen demand
mgd = million gallons per day
NH_3-N = ammonia nitrogen
NO_2 or NO_2-N = nitrite nitrogen
No_3 or NO_3-N = nitrate nitrogen
Fec Coli = Fecal coliforms
Fec Strep = Fecal streptococci

TABLE 14. DAILY RESULTS FOR WATER TEMPERATURE, AIR TEMPERATURE AND FLOW

INDICATOR SAMPLING		WATER TEMP (°C)					AIR (°F) TEMP	FLOW (MGD
		1	2	3	4	5		
MO	DY							
12	13	12	4	3	2	2	39	.240
12	14	12	4	3	2	2	52	.230
12	15	12	4	3	3	4	24	.240
12	16	12	4	3	3	3	22	.230
12	17	11	4	3	3	2	2	.230
12	18	11	3	2	2	2	2	.230
12	19	11	3	2	2	2	20	.220
MEAN		11.6	3.7	2.7	2.4	2.4	23.0	.231
STD DEV		.5	.5	.5	.5	.8	18.2	.007
1	3	10	3	2	2	2	20	.210
1	4	10	2	2	2	2	9	.210
1	5	10	2	2	2	2	11	.210
1	6	11	2	2	2	2	20	.210
1	7	9	2	2	2	2	10	.210
1	8	10	2	2	2	2	-9	.210
1	9	10	2	2	2	2	0	.210
1	10	10	2	1	2	1	0	.210
1	11	10	2	1	1	1	18	.210
1	12	10	2	1	1	1	20	.200
1	13	10	1	1	1	1	12	.200
1	14	10	1	1	1	1	12	.210
1	15	11	1	1	1	1	18	.210
1	16	10	1	1	1	1	18	.220
1	17	10	1	1	1	1	10	.220
1	18	10	1	1	1	1	10	.210
1	19	10	1	1	1	1	13	.210
1	20	10	1	1	1	1	9	.210
1	21	9	1	1	1	1	16	.200
1	22	10	1	1	1	1	8	.210
1	23	10	1	1	1	1	20	.220
1	24	10	1	1	1	1	25	.210
1	25	10	1	1	1	1	15	.210
1	26	10	1	1	1	1	-10	.210
1	27	9	1	1	1	1	16	.200
1	23	10	1	1	1	1	14	.190
1	29	10	1	1	1	1	18	.230
1	30	9	1	1	1	1	-12	.220
1	31	9	1	1	1	1	22	.190
2	1	9	1	1	1	1	10	.190
MEAN		9.9	1.4	1.2	1.3	1.2	11.4	.209
STD DEV		.5	.5	.4	.4	.4	8.4	.008
2	16	9	1	1	1	1	32	.240
2	17	9	1	1	1	1	32	.260
2	18	9	1	1	1	1	30	.220
2	19	9	1	1	1	1	30	.240
2	20	9	1	1	1	1	35	.260
2	21	9	1	1	1	1	18	.230
2	22	9	1	1	1	1	15	.240
MEAN		9.0	1.0	1.0	1.0	1.0	27.4	.241
STD DEV		.0	.0	.0	.0	.0	2.9	.005
SEA MEAN		10.0	1.7	1.4	1.4	1.4	15.8	.217
SEA STD DEV		.9	1.0	.7	.6	.7	12.5	.016

(continued)

TABLE 14 (continued)

INDICATOR SAMPLING MO	DY	WATER TEMP (°C) 1	2	3	4	5	AIR (°F) TEMP	FLOW (MGD)
3	13	8	4	3	2	2	28	.370
3	14	8	4	3	2	2	23	.336
3	15	8	4	3	3	3	32	.326
3	16	8	4	3	3	3	20	.307
3	17	8	4	3	3	3	36	.297
3	18	8	5	4	4	4	42	.299
3	19	9	6	5	5	5	60	.315
MEAN		8.1	4.4	3.4	3.1	3.1	34.4	.321
STD DEV		.4	.8	.8	1.1	1.1	13.5	.026
4	1	9	8	8	8	8	33	.323
4	2	9	8	8	8	8	35	.340
4	3	9	8	8	8	8	40	.369
4	4	9	8	8	9	9	38	.291
4	5	9	9	9	9	9	40	.293
4	6	10	10	10	10	10	42	.276
4	7	10	11	11	11	11	44	.270
4	8	10	10	10	10	10	38	.270
4	9	10	11	11	11	11	40	.270
4	10	10	10	10	10	10	52	.308
4	11	10	10	10	10	10	48	.270
4	12	10	10	10	10	10	34	.270
4	13	10	10	10	10	10	42	.270
4	14	10	11	12	12	12	50	.270
4	15	11	13	13	13	13	62	.270
4	16	11	14	15	15	15	63	.278
4	17	11	15	16	16	16	63	.270
4	18	11	16	17	17	17	65	.270
4	19	10	15	15	15	15	46	.270
4	20	10	14	15	15	15	52	.274
4	21	10	14	14	15	15	58	.306
4	22	11	12	13	13	13	56	.297
4	23	11	12	13	13	13	48	.313
4	24	10	11	12	12	12	40	.430
4	25	11	9	10	11	11	39	.334
4	26	11	8	9	9	9	34	.333
4	27	11	8	9	9	9	36	.318
4	28	11	11	12	12	12	43	.300
4	29	11	11	12	13	13	46	.293
4	30	11	12	13	13	13	54	.293
MEAN		10.2	11.0	11.4	11.6	11.6	46.0	.298
STD DEV		.7	2.1	2.3	2.3	2.3	8.6	.033
5	8	11	12	12	13	13	37	.270
5	9	11	12	12	13	14	56	.270
5	10	11	12	13	14	15	51	.270
5	11	11	12	13	14	14	48	.270
5	12	11	12	13	14	15	44	.270
5	13	11	12	13	15	16	56	.270
5	14	11	12	13	15	16	55	.270
MEAN		11.0	12.0	12.7	14.0	14.7	49.6	.270
STD DEV		.0	.0	.2	.3	.4	2.7	.000
SEA MEAN		10.0	10.1	10.4	10.6	10.7	44.7	.297
SEA STD DEV		1.1	3.2	3.7	4.0	4.1	10.8	.035

(continued)

TABLE 14 (continued)

INDICATOR SAMPLING		WATER TEMP (°C)					AIR (°F) TEMP	FLOW (MGD)
MO	DY	1	2	3	4	5		
6	21	14	21	23	23	23	64	.270
6	22	14	21	23	23	23	66	.260
6	23	14	21	22	23	23	66	.270
4	24	14	21	22	22	22	61	.260
6	25	13	20	22	22	22	59	.270
6	26	13	21	23	23	23	68	.270
6	27	14	21	23	23	23	70	.270
MEAN		13.7	20.9	22.6	22.7	22.7	64.9	.267
STD DEV		.5	.4	.5	.5	.5	3.8	.005
7	1	14	22	23	23	23	58	.260
7	2	14	22	23	23	23	59	.270
7	3	14	23	24	24	24	59	.270
7	4	14	23	24	24	24	58	.270
7	5	15	23	24	24	25	68	.270
7	6	15	23	25	25	25	70	.270
4	7	15	23	25	25	24	70	.260
7	8	15	23	25	25	25	70	.270
7	9	15	23	25	25	25	72	.260
7	10	15	24	25	25	25	78	.270
7	11	15	24	25	25	25	80	.270
7	12	15	24	25	25	25	58	.260
7	13	15	24	25	25	25	68	.250
7	14	15	25	26	26	26	76	.260
7	15	15	25	26	26	27	70	.260
7	16	15	24	25	25	25	69	.260
7	17	15	24	25	25	25	66	.270
7	18	15	24	25	25	25	60	.270
7	19	15	24	25	25	25	70	.260
7	20	15	22	24	24	24	71	.270
7	21	15	22	24	24	24	66	.260
7	22	15	22	24	24	24	71	.260
7	23	15	23	25	25	25	72	.270
7	24	15	24	25	25	25	70	.270
7	25	15	24	25	26	26	70	.270
7	26	15	22	24	24	24	72	.260
7	27	15	22	24	24	24	70	.260
7	28	15	24	25	26	26	67	.270
7	29	15	23	25	26	26	68	.260
7	30	15	23	25	26	26	67	.260
MEAN		14.9	23.3	24.7	24.8	24.8	68.1	.265
STD DEV		.3	.8	.6	.8	.8	5.1	.005
8	11	16	23	24	24	24	70	.260
8	12	16	23	24	24	24	70	.270
8	13	16	23	24	24	24	68	.270
8	14	16	23	24	24	24	60	.270
8	15	16	22	23	23	23	58	.270
8	16	16	21	22	22	22	56	.260
8	17	16	21	22	22	22	60	.260
MEAN		16.0	22.3	23.3	23.3	23.3	63.1	.266
STD DEV		.0	.4	.4	.4	.4	2.2	.002
SEA MEAN		14.9	22.7	24.1	24.2	24.2	66.8	.265
SEA STD DEV		.7	1.2	1.1	1.2	1.2	5.7	.005

(continued)

TABLE 14 (concluded)

INDICATOR SAMPLING MO	DY	WATER TEMP (°C)					AIR (°F) TEMP	FLOW (MGD)
		1	2	3	4	5		
9	18	16	17	17	17	17	49	.270
9	19	16	17	17	17	17	62	.270
9	20	16	17	17	17	17	52	.260
9	21	16	16	17	17	17	48	.260
9	22	16	16	16	16	16	38	.250
9	23	16	16	16	16	16	46	.250
9	24	15	16	16	16	16	35	.250
MEAN		15.9	16.4	16.6	16.6	16.6	47.1	.259
STD DEV		.4	.5	.5	.5	.5	9.0	.009
10	1	15	15	16	16	16	48	.250
10	2	15	15	16	16	16	54	.260
10	3	15	15	16	17	17	50	.260
10	4	15	15	16	16	17	60	.250
10	5	15	15	16	16	16	47	.260
10	6	15	15	15	15	15	35	.250
10	7	15	14	14	14	14	40	.250
10	8	15	15	14	14	14	30	.250
10	9	15	15	15	15	15	36	.250
10	10	15	15	15	15	15	36	.250
10	11	15	15	15	15	15	41	.250
10	12	15	15	15	15	15	54	.230
10	13	15	14	14	14	14	50	.240
10	14	15	14	14	14	14	42	.240
10	15	15	14	14	14	14	44	.240
10	16	15	14	13	13	13	40	.250
10	17	15	12	11	11	11	24	.250
10	18	14	12	10	10	10	26	.240
10	19	14	11	10	10	10	34	.240
10	20	14	11	9	9	9	28	.230
10	21	14	10	7	9	9	32	.230
10	22	14	9	7	7	7	22	.240
10	23	14	8	7	7	7	36	.260
10	24	14	8	7	7	7	39	.260
10	25	14	8	8	8	8	36	.260
10	26	14	8	7	7	7	32	.260
10	27	14	8	7	7	7	24	.250
10	28	14	7	6	6	6	26	.260
10	29	14	7	6	6	6	34	.260
10	30	14	7	6	6	6	42	.270
MEAN		14.6	12.0	11.6	11.6	11.7	38.1	.250
STD DEV		.5	2.8	3.4	3.4	3.5	8.8	.009
.1	24	13	9	8	8	7	30	.114
11	25	13	7	6	5	5	16	.118
11	26	12	6	6	5	5	18	.115
11	27	12	6	6	4	4	24	.113
11	28	11	7	6	4	4	24	.135
11	29	11	6	6	5	5	26	.137
11	30	11	6	6	6	6	12	.133
MEAN		11.9	6.7	6.3	5.3	5.1	21.4	.124
STD DEV		.3	.4	.3	.5	.4	2.4	.004
SEA MEAN		14.3	11.9	11.5	11.4	11.4	36.9	.231
SEA STD DEV		1.3	3.8	4.3	4.6	4.6	11.8	.048

TABLE 15. DAILY RESULTS FOR pH AND ALKALINITY

INDICATOR SAMPLING		P H					ALKALINITY (MG/L)				
MO	DY	1	2	3	4	5	1	2	3	4	5
12	13	7.3	7.5	7.5	7.6	7.6	414	418	390	389	368
12	14	7.3	7.5	7.5	7.6	7.5	420	440	392	380	380
12	15	7.3	7.5	7.5	7.5	7.5	404	416	396	370	366
12	16	7.3	7.5	7.5	7.5	7.6	440	416	404	388	384
12	17	7.3	7.5	7.5	7.5	7.6	408	424	412	370	388
12	18	7.3	7.5	7.5	7.5	7.5	428	428	430	380	388
12	19	7.4	7.5	7.5	7.6	7.6	419	423	404	379	379
MEAN		7.31	7.50	7.50	7.54	7.56	419.0	423.6	404.0	379.4	379.0
STD DEV		.04	.00	.00	.05	.05	12.2	8.5	13.8	7.6	8.9
1	3	7.4	7.5	7.5	7.5	7.5	420	409	416	410	408
1	4	7.3	7.5	7.5	7.5	7.6	435	424	418	410	416
1	5	7.3	7.5	7.5	7.5	7.5	440	436	438	432	414
1	6	7.4	7.5	7.4	7.5	7.5	424	424	432	436	432
1	7	7.5	7.5	7.5	7.4	7.6	422	428	432	424	428
1	8	7.5	7.5	7.5	7.5	7.5	416	444	430	424	420
1	9	7.5	7.5	7.5	7.5	7.6	476	452	440	428	430
1	10	7.4	7.5	7.4	7.5	7.5	412	448	452	476	428
1	11	7.4	7.5	7.5	7.5	7.5	428	442	446	444	448
1	12	7.4	7.4	7.5	7.5	7.5	444	448	448	444	436
1	13	7.3	7.4	7.4	7.5	7.4	436	454	446	438	444
1	14	7.3	7.5	7.5	7.5	7.4	380	444	448	432	436
1	15	7.3	7.5	7.5	7.5	7.4	422	446	438	430	420
1	16	7.3	7.4	7.5	7.5	7.4	416	448	436	444	436
1	17	7.4	7.5	7.5	7.5	7.4	428	434	444	442	442
1	18	7.3	7.4	7.5	7.5	7.4	414	444	444	440	440
1	19	7.3	7.4	7.5	7.6	7.5	428	450	452	456	456
1	20	7.3	7.5	7.5	7.5	7.4	424	448	454	458	458
1	21	7.4	7.5	7.6	7.5	7.4	423	446	454	463	450
1	22	7.3	7.4	7.5	7.6	7.5	404	440	449	446	443
1	23	7.2	7.4	7.5	7.5	7.4	418	448	449	454	453
1	24	7.3	7.5	7.5	7.5	7.4	419	446	457	455	459
1	25	7.3	7.5	7.5	7.5	7.5	414	443	446	450	454
1	26	7.3	7.4	7.5	7.6	7.5	421	445	458	454	455
1	27	7.3	7.5	7.6	7.6	7.5	368	434	457	460	448
1	28	7.4	7.5	7.5	7.5	7.4	412	441	455	455	452
1	29	7.4	7.5	7.5	7.5	7.4	408	437	449	455	453
1	30	7.3	7.4	7.5	7.5	7.4	425	434	452	452	453
1	31	7.4	7.5	7.5	7.5	7.5	422	433	446	451	461
2	1	7.4	7.5	7.5	7.5	7.4	410	440	451	445	447
MEAN		7.35	7.47	7.50	7.51	7.46	420.3	440.3	444.6	443.6	440.7
STD DEV		.07	.04	.04	.04	.06	16.6	8.7	9.6	13.6	13.3
2	16	7.3	7.4	7.4	7.4	7.3	402	410	395	400	408
2	17	7.3	7.4	7.4	7.4	7.3	381	403	402	380	403
2	18	7.3	7.4	7.4	7.4	7.3	377	401	388	390	398
2	19	7.3	7.4	7.4	7.4	7.4	367	405	397	399	402
2	20	7.3	7.4	7.4	7.4	7.4	374	402	389	392	396
2	21	7.4	7.4	7.4	7.4	7.4	393	400	392	396	388
2	22	7.3	7.4	7.4	7.4	7.4	396	397	387	392	401
MEAN		7.31	7.40	7.40	7.40	7.36	384.3	402.6	392.9	392.7	399.4
STD DEV		.01	.00	.00	.00	.02	4.8	1.5	2.0	2.5	2.4
SEA MEAN		7.34	7.46	7.48	7.50	7.46	414.4	431.7	429.9	425.3	424.3
SEA STD DEV		.07	.05	.05	.06	.08	21.2	16.7	24.3	30.3	28.0

(continued)

TABLE 15 (continued)

INDICATOR		P H					ALKALINITY (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
3	13	7.3	7.4	7.5	7.6	7.5	388	380	368	360	362
3	14	7.4	7.4	7.5	7.6	7.5	362	378	364	356	356
3	15	7.3	7.5	7.6	7.6	7.6	390	391	387	388	374
3	16	7.3	7.5	7.6	7.6	7.6	394	403	393	371	374
3	17	7.3	7.6	7.6	7.6	7.6	397	400	396	372	377
3	18	7.3	7.6	7.6	7.6	7.6	404	400	397	372	373
3	19	7.4	7.5	7.6	7.6	7.6	400	402	399	369	377
MEAN		7.33	7.50	7.57	7.60	7.57	390.7	393.4	386.3	369.7	370.4
STD DEV		.05	.08	.05	.00	.05	13.6	10.6	14.4	10.2	8.1
4	1	7.2	7.5	7.7	7.8	7.8	382	368	371	333	366
4	2	7.2	7.5	7.7	7.7	7.7	384	392	390	358	346
4	3	7.3	7.5	7.7	7.7	7.7	386	399	367	360	366
4	4	7.3	7.5	7.7	7.7	7.6	384	397	380	359	369
4	5	7.2	7.6	7.7	7.7	7.8	394	400	371	350	369
4	6	7.2	7.6	7.7	7.7	7.8	391	391	376	350	378
4	7	7.2	7.6	7.7	7.7	7.8	403	405	382	357	360
4	8	7.2	7.6	7.7	7.7	7.8	398	402	378	347	362
4	9	7.2	7.5	7.6	7.7	7.8	399	396	379	350	368
4	10	7.3	7.6	7.7	7.8	7.8	393	405	381	341	366
4	11	7.3	7.5	7.6	7.6	7.7	398	405	384	345	365
4	12	7.2	7.5	7.6	7.7	7.8	398	405	385	346	372
4	13	7.2	7.5	7.6	7.7	7.8	398	407	387	344	366
4	14	7.2	7.5	7.6	7.7	7.8	396	405	389	345	370
4	15	7.2	7.5	7.6	7.7	7.8	394	404	389	331	370
4	16	7.2	7.5	7.6	7.7	7.8	383	403	383	324	377
4	17	7.3	7.5	7.6	7.6	7.7	386	412	382	342	369
4	18	7.3	7.5	7.6	7.6	7.7	380	411	379	332	372
4	19	7.2	7.5	7.6	7.7	7.7	401	409	388	356	383
4	20	7.2	7.5	7.6	7.7	7.7	392	406	388	346	378
4	21	7.2	7.5	7.6	7.7	7.7	386	406	386	348	379
4	22	7.2	7.5	7.6	7.7	7.7	380	403	376	337	368
4	23	7.2	7.5	7.6	7.6	7.7	405	402	390	343	364
4	24	7.3	7.4	7.5	7.6	7.7	374	399	380	345	363
4	25	7.3	7.4	7.5	7.6	7.7	324	404	380	340	369
4	26	7.2	7.4	7.5	7.6	7.7	387	397	380	342	348
4	27	7.2	7.4	7.5	7.6	7.8	358	406	399	336	365
4	28	7.2	7.4	7.6	7.7	7.8	379	401	372	347	372
4	29	7.2	7.5	7.6	7.7	7.8	392	410	377	346	376
4	30	7.2	7.5	7.6	7.7	7.8	391	406	380	344	369
MEAN		7.23	7.50	7.62	7.66	7.75	387.2	402.5	381.6	344.9	368.2
STD DEV		.04	.05	.06	.05	.05	13.8	5.2	6.1	7.7	7.1
5	8	7.2	7.6	7.8	7.9	8.0	392	400	361	356	343
5	9	7.2	7.6	7.8	7.9	8.0	361	402	362	336	338
5	10	7.2	7.6	7.7	7.9	8.0	402	402	361	341	345
5	11	7.2	7.6	7.8	8.0	8.0	397	405	364	345	344
5	12	7.2	7.6	7.7	8.0	8.0	399	402	349	320	345
5	13	7.2	7.6	7.8	7.9	8.0	390	406	328	305	313
5	14	7.2	7.6	7.8	7.9	8.2	397	402	336	324	314
MEAN		7.20	7.60	7.77	7.93	8.03	394.0	402.7	351.6	332.7	334.6
STD DEV		.00	.00	.02	.02	.03	2.6	.8	5.4	6.5	5.5
SEA MEAN		7.24	7.52	7.63	7.71	7.77	388.8	401.1	377.6	346.9	363.2
SEA STD DEV		.06	.07	.09	.11	.14	14.2	7.1	14.9	15.0	15.5

(continued)

TABLE 15 (continued)

INDICATOR		P H					ALKALINITY (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
6	21	7.2	7.6	7.7	7.8	7.8	426	442	436	399	395
6	22	7.3	7.6	7.7	7.8	7.8	427	453	435	403	416
6	23	7.3	7.6	7.7	7.8	7.8	408	443	428	397	404
6	24	7.3	7.6	7.7	7.8	7.8	407	441	424	402	408
6	25	7.3	7.6	7.7	7.8	7.8	403	435	435	415	408
6	26	7.3	7.6	7.7	7.8	7.8	407	434	431	398	407
6	27	7.3	7.6	7.7	7.8	7.8	404	429	442	405	414
MEAN		7.29	7.60	7.70	7.80	7.80	411.7	439.6	433.0	402.7	407.4
STD DEV		.04	.00	.00	.00	.00	10.3	7.8	5.9	6.1	6.9
7	1	7.3	7.6	7.7	7.8	7.8	374	444	410	399	409
7	2	7.3	7.6	7.7	7.8	7.8	397	412	417	428	405
7	3	7.3	7.6	7.7	7.8	7.8	400	420	433	393	419
7	4	7.3	7.7	7.7	7.8	7.8	424	439	435	391	416
7	5	7.3	7.7	7.7	7.8	7.8	439	437	424	387	422
7	6	7.3	7.6	7.7	7.8	7.8	441	433	419	373	425
7	7	7.4	7.6	7.7	7.8	7.8	422	434	419	387	407
7	8	7.2	7.6	7.7	7.7	7.7	404	425	415	401	406
7	9	7.3	7.6	7.7	7.7	7.7	400	420	425	397	400
7	10	7.3	7.6	7.7	7.7	7.7	399	427	442	382	402
7	11	7.3	7.6	7.7	7.7	7.7	393	440	446	393	405
7	12	7.3	7.6	7.7	7.7	7.7	397	431	430	382	403
7	13	7.3	7.6	7.7	7.8	7.8	402	439	440	385	408
7	14	7.3	7.6	7.7	7.8	7.8	401	448	434	375	400
7	15	7.3	7.6	7.7	7.8	7.8	404	449	425	375	405
7	16	7.3	7.6	7.7	7.8	7.8	398	437	422	374	401
7	17	7.3	7.6	7.7	7.8	7.8	399	437	427	373	389
7	18	7.3	7.6	7.7	7.8	7.8	400	445	425	377	391
7	19	7.3	7.6	7.7	7.8	7.8	420	448	424	374	411
7	20	7.3	7.6	7.7	7.7	7.7	401	447	427	384	416
7	21	7.3	7.6	7.7	7.7	7.7	392	444	431	387	402
7	22	7.3	7.6	7.7	7.7	7.7	387	433	434	386	404
7	23	7.3	7.6	7.6	7.7	7.7	387	436	444	383	409
7	24	7.3	7.6	7.7	7.7	7.7	392	439	451	383	416
7	25	7.3	7.6	7.7	7.7	7.7	400	443	455	389	414
7	26	7.3	7.6	7.7	7.8	7.8	393	442	453	382	415
7	27	7.3	7.6	7.7	7.7	7.7	396	455	441	399	413
7	28	7.3	7.6	7.7	7.7	7.7	385	451	445	383	422
7	29	7.3	7.6	7.7	7.7	7.7	394	453	446	383	417
7	30	7.3	7.6	7.7	7.7	7.7	388	455	449	380	420
MEAN		7.30	7.61	7.70	7.75	7.75	401.0	438.8	432.9	386.2	409.1
STD DEV		.02	.02	.02	.05	.05	13.3	9.5	11.0	10.1	7.9
8	11	7.2	7.5	7.6	7.7	7.7	346	477	431	374	389
8	12	7.3	7.5	7.6	7.7	7.7	385	439	440	375	393
8	13	7.2	7.5	7.6	7.7	7.7	383	438	437	368	391
8	14	7.3	7.5	7.6	7.7	7.7	380	438	432	362	390
8	15	7.3	7.5	7.6	7.7	7.7	381	433	431	365	397
8	16	7.3	7.5	7.5	7.6	7.6	384	442	433	361	393
8	17	7.3	7.5	7.5	7.6	7.6	367	443	432	371	393
MEAN		7.27	7.50	7.57	7.67	7.67	375.1	444.3	433.7	368.0	392.3
STD DEV		.02	.00	.02	.02	.02	5.3	5.5	1.3	2.1	1.0
SEA MEAN		7.29	7.59	7.68	7.75	7.75	398.6	439.8	433.1	385.9	406.2
SEA STD DEV		.03	.04	.05	.06	.06	17.7	10.9	10.4	13.9	9.9

(continued)

TABLE 15 (concluded)

INDICATOR		P H					ALKALINITY (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
9	18	7.2	7.4	7.5	7.7	7.7	368	410	434	383	392
9	19	7.2	7.4	7.5	7.7	7.7	373	427	429	393	400
9	20	7.2	7.5	7.5	7.6	7.7	396	419	430	390	416
9	21	7.2	7.5	7.5	7.6	7.6	388	424	412	382	397
9	22	7.2	7.5	7.5	7.6	7.6	368	429	423	379	392
9	23	7.2	7.5	7.5	7.5	7.5	369	448	431	387	394
9	24	7.2	7.5	7.5	7.5	7.5	372	431	418	379	393
MEAN		7.20	7.47	7.50	7.60	7.61	376.3	426.9	425.3	384.7	398.0
STD DEV		.00	.05	.00	.08	.09	11.1	11.7	8.0	5.4	9.3
10	1	7.3	7.5	7.5	7.5	7.5	372	431	420	393	395
10	2	7.3	7.5	7.5	7.5	7.5	370	417	426	382	393
10	3	7.3	7.5	7.5	7.5	7.5	370	451	422	379	396
10	4	7.2	7.5	7.5	7.4	7.4	376	445	434	387	396
10	5	7.3	7.5	7.5	7.5	7.5	383	447	427	388	410
10	6	7.2	7.5	7.5	7.5	7.5	362	446	428	378	409
10	7	7.2	7.5	7.5	7.6	7.6	377	443	426	385	399
10	8	7.2	7.5	7.5	7.5	7.5	376	433	413	381	398
10	9	7.2	7.5	7.5	7.5	7.5	379	443	415	373	405
10	10	7.2	7.5	7.5	7.5	7.5	373	434	416	393	394
10	11	7.2	7.5	7.5	7.5	7.5	375	414	413	381	393
10	12	7.2	7.5	7.5	7.5	7.5	375	429	404	373	396
10	13	7.2	7.5	7.5	7.5	7.5	361	432	416	382	374
10	14	7.3	7.5	7.5	7.4	7.4	362	441	429	379	393
10	15	7.2	7.5	7.5	7.4	7.4	375	421	418	363	395
10	16	7.2	7.5	7.5	7.5	7.5	421	431	430	373	393
10	17	7.2	7.5	7.5	7.5	7.5	383	435	423	375	393
10	18	7.2	7.5	7.5	7.5	7.5	396	417	417	375	392
10	19	7.3	7.5	7.5	7.5	7.5	369	416	414	365	395
10	20	7.2	7.5	7.5	7.5	7.5	370	419	418	367	396
10	21	7.2	7.5	7.5	7.5	7.4	366	424	419	374	393
10	22	7.2	7.5	7.5	7.5	7.5	365	417	423	363	400
10	23	7.3	7.5	7.5	7.5	7.5	365	423	419	369	403
10	24	7.3	7.5	7.5	7.5	7.5	373	421	414	371	407
10	25	7.3	7.5	7.5	7.5	7.5	372	425	416	373	407
10	26	7.2	7.5	7.5	7.4	7.4	353	428	413	396	405
10	27	7.2	7.5	7.5	7.5	7.5	371	434	423	359	406
10	28	7.3	7.5	7.5	7.5	7.5	363	422	423	357	398
10	29	7.3	7.5	7.5	7.5	7.5	373	417	413	371	396
10	30	7.5	7.5	7.5	7.5	7.5	363	414	405	371	397
MEAN		7.25	7.50	7.50	7.49	7.49	373.0	429.0	419.2	375.9	397.6
STD DEV		.06	.00	.00	.04	.04	11.0	9.9	6.3	6.9	6.3
11	24	7.4	7.4	7.5	7.5	7.6	408	436	408	386	395
11	25	7.4	7.4	7.5	7.6	7.6	404	399	430	394	406
11	26	7.2	7.4	7.5	7.5	7.5	427	411	419	377	387
11	27	7.3	7.4	7.5	7.5	7.5	439	436	409	394	404
11	28	7.2	7.4	7.5	7.6	7.5	441	450	412	401	402
11	29	7.3	7.4	7.5	7.6	7.6	443	445	432	407	399
11	30	7.4	7.4	7.5	7.5	7.6	406	438	411	408	396
MEAN		7.31	7.40	7.50	7.54	7.56	424.0	430.7	417.3	395.3	398.4
STD DEV		.03	.00	.00	.02	.02	6.6	7.0	3.7	4.2	2.4
SEA MEAN		7.25	7.48	7.50	7.52	7.52	381.6	428.9	419.9	380.4	397.6
SEA STD DEV		.07	.04	.00	.06	.07	22.6	12.3	7.9	11.9	7.2

TABLE 16. DAILY RESULTS FOR BOD AND COD

INDICATOR		BOD_5 (MG/L)					COD (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
12	13	97	7	4	5	8	140	26	16	12	18
12	14	94	23	5	4	9	194	42	18	18	29
12	15	99	16	7	8	9	284	32	16	14	16
12	16	83	8	6	6	7	188	40	40	38	38
12	17	54	7	8	5	7	180	30	28	28	36
12	18	101	8	6	8	8	200	28	12	10	10
12	19	93	11	10	5	8	276	39	32	26	28
MEAN		88.7	11.4	6.6	5.9	8.0	208.9	33.9	23.1	20.9	25.0
STD DEV		16.4	6.0	2.0	1.6	.8	52.4	6.4	10.3	10.2	10.6
1	3	95	20	5	4	7	214	39	27	31	23
1	4	96	10	6	4	4	316	54	46	36	36
1	5	107	10	7	5	7	324	54	44	38	40
1	6	85	10	10	5	8	226	48	36	36	40
1	7	138	10	9	6	9	294	74	44	36	30
1	8	85	12	10	6	9	146	36	38	26	30
1	9	95	10	6	6	7	218	52	42	48	38
1	10	81	9	7	6	8	196	46	42	48	40
1	11	98	9	7	7	9	176	46	52	54	44
1	12	104	14	6	7	11	232	60	49	43	43
1	13	71	9	8	8	10	194	50	43	38	43
1	14	85	9	7	7	11	209	49	68	35	40
1	15	84	7	7	8	12	223	54	45	35	45
1	16	100	8	14	7	11	212	32	28	28	32
1	17	98	(12)	13	8	11	153	58	32	49	32
1	18	119	14	9	9	9	311	43	35	35	43
1	19	107	12	6	8	10	307	48	35	43	43
1	20	81	10	7	7	14	194	45	53	49	49
1	21	81	12	10	8	14	288	65	41	53	61
1	22	109	12	15	10	15	191	49	45	35	51
1	23	69	12	16	11	10	153	41	31	39	39
1	24	74	14	14	6	14	164	42	38	34	38
1	25	103	14	16	7	15	206	42	38	34	29
1	26	103	18	10	7	14	248	67	46	42	48
1	27	97	15	12	9	11	206	48	37	46	52
1	28	115	13	11	8	7	222	59	46	35	42
1	29	91	19	13	8	9	249	64	42	37	35
1	30	118	13	8	7	9	332	61	59	61	64
1	31	101	12	6	6	9	246	70	57	44	52
2	1	87	15	10	7	9	194	40	27	29	26
MEAN		95.9	12.1	9.5	7.1	10.1	228.1	51.2	42.2	39.9	40.9
STD DEV		13.8	2.6	3.0	1.4	2.4	47.9	9.3	8.5	7.4	8.5
2	16	96	11	17	11	7	303	55	40	50	39
2	17	92	9	7	6	6	213	46	43	30	35
2	18	79	12	9	7	6	284	57	48	35	33
2	19	77	11	8	5	4	219	36	31	18	19
2	20	38	7	5	5	2	122	44	38	29	25
2	21	79	8	16	5	3	377	49	40	33	34
2	22	49	9	6	5	5	243	32	28	27	27
MEAN		72.9	9.6	9.7	6.3	4.7	251.6	45.6	38.3	31.7	30.3
STD DEV		8.0	.7	1.8	.8	.7	30.1	3.4	2.6	3.6	2.6
SEA MEAN		91.1	11.6	9.1	6.7	8.9	228.8	47.5	38.5	35.6	36.7
SEA STD DEV		18.3	3.6	3.5	1.7	3.1	57.9	11.4	11.4	11.2	11.2

(continued)

TABLE 16 (continued)

INDICATOR SAMPLING		BOD_5 (MG/L) 1	2	3	4	5	COD (MG/L) 1	2	3	4	5
MO	DY										
3	13	49	18	19	12	11	167	52	58	58	54
3	14	30	9	17	14	9	105	38	41	43	34
3	15	55	14	17	12	10	132	52	47	47	47
3	16	32	18	14	12	11	95	60	55	49	44
3	17	39	15	16	16	12	135	58	67	60	69
3	18	30	15	12	17	13	62	59	57	62	62
3	19	27	9	7	15	10	114	47	53	47	56
MEAN		37.4	14.0	14.6	14.0	10.9	115.7	52.3	54.0	52.3	52.3
STD DEV		10.8	3.7	4.0	2.1	1.3	33.4	7.8	8.3	7.5	11.7
4	1	77	23	28	31	14	124	69	69	76	80
4	2	32	13	14	25	10	95	68	63	64	69
4	3	48	18	36	24	10	172	56	72	64	58
4	4	32	14	18	23	9	145	55	47	67	46
4	5	52	16	34	31	16	155	63	99	71	96
4	6	83	12	21	28	14	250	61	60	74	68
4	7	44	11	18	20	18	93	64	71	76	75
4	8	83	9	22	28	13	208	48	64	60	79
4	9	62	37	15	23	8	136	90	69	69	67
4	10	42	8	6	6	8	154	56	48	58	50
4	11	47	13	12	18	6	126	51	51	131	42
4	12	52	9	15	23	12	156	55	59	69	63
4	13	44	14	15	15	10	99	55	52	47	51
4	14	29	8	13	17	10	69	50	32	26	32
4	15	32	18	9	15	14	86	66	45	39	35
4	16	56	5	5	10	6	97	43	26	38	38
4	17	62	8	8	10	6	150	37	40	35	37
4	18	53	8	11	12	2	144	62	78	47	71
4	19	58	12	17	13	12	111	52	53	48	58
4	20	57	10	15	10	6	78	24	31	51	35
4	21	68	7	13	14	7	137	27	24	31	31
4	22	73	6	11	18	7	98	31	31	21	40
4	23	63	7	14	15	10	110	35	31	35	40
4	24	46	5	12	16	14	118	33	45	43	43
4	25	94	7	11	14	6	221	30	24	45	37
4	26	61	10	10	9	6	97	31	37	114	35
4	27	59	10	13	16	11	63	30	24	40	40
4	28	49	11	13	16	11	78	37	45	51	58
4	29	34	12	16	15	9	76	39	44	47	53
4	30	56	13	19	17	14	152	33	68	69	70
MEAN		54.9	11.6	15.5	17.7	10.0	126.6	48.4	50.1	56.9	53.2
STD DEV		14.6	5.6	6.4	5.9	3.3	40.7	14.2	16.8	21.2	15.5
5	8	58	32	20	6	14	157	43	71	45	49
5	9	91	19	30	14	11	206	47	65	84	80
5	10	112	13	31	22	17	226	47	80	99	78
5	11	65	12	19	20	12	145	53	88	92	70
5	12	65	18	21	21	15	145	60	97	52	80
5	13	57	15	14	16	9	100	64	116	78	83
5	14	49	15	15	23	11	144	65	104	109	80
MEAN		71.0	17.7	21.4	17.4	12.7	160.4	54.1	88.7	79.9	74.3
STD DEV		8.4	2.5	2.5	2.2	1.0	15.8	3.3	6.8	8.9	4.4
SEA MEAN		54.7	13.1	16.3	17.1	10.5	130.2	49.9	56.8	59.8	56.4
SEA STD DEV		18.9	6.3	6.9	6.1	3.4	44.6	13.9	22.1	23.3	17.4

(continued)

TABLE 16 (continued)

INDICATOR		BOD5(MG/L)					COD (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
6	21	127	17	25	11	8	263	45	49	61	39
6	22	90	14	14	6	15	181	34	29	22	18
6	23	70	13	16	5	8	144	72	52	49	49
6	24	55	13	14	6	8	159	60	49	47	47
6	25	73	12	16	11	8	162	46	41	35	39
6	26	82	14	15	12	10	217	65	58	55	60
6	27	102	16	24	17	18	177	69	44	33	36
MEAN		85.6	14.1	17.7	9.7	10.7	186.1	55.9	46.0	43.1	41.1
STD DEV		23.6	1.8	4.7	4.3	4.1	41.0	14.3	9.3	13.7	13.1
7	1	77	22	27	14	19	162	68	61	84	84
7	2	77	15	15	8	14	165	80	40	39	55
7	3	93	31	29	20	13	274	100	63	55	51
7	4	122	21	14	17	8	165	84	48	48	40
7	5	139	23	26	23	15	319	101	52	46	65
7	6	131	25	24	9	9	312	111	54	57	54
7	7	118	24	10	21	15	348	96	61	69	72
7	8	80	21	14	32	15	246	94	63	92	85
7	9	93	20	16	23	23	147	72	56	88	54
7	10	84	20	11	21	11	223	78	65	56	54
7	11	105	17	10	20	18	229	69	51	77	81
7	12	109	23	13	23	25	288	72	48	72	58
7	13	73	15	9	16	22	330	78	78	64	60
7	14	70	14	10	17	21	175	57	45	69	55
7	15	72	31	13	18	16	182	77	61	85	69
7	16	63	24	14	15	17	144	49	64	71	53
7	17	87	17	11	12	15	200	66	68	58	51
7	18	74	15	11	14	15	334	64	58	68	60
7	19	118	23	22	19	35	269	65	58	57	83
7	20	75	21	12	10	20	241	54	41	53	46
7	21	67	23	15	23	18	345	54	45	66	60
7	22	84	48	15	15	17	169	73	56	65	58
7	23	92	40	12	10	21	184	75	49	56	52
7	24	105	30	20	17	26	163	78	47	55	56
7	25	116	28	18	17	29	296	83	56	60	64
7	26	101	35	23	16	34	166	74	64	80	79
7	27	101	24	20	17	30	200	60	48	65	44
7	28	91	22	19	19	30	188	61	50	51	73
7	29	87	13	19	12	24	164	64	57	58	48
7	30	75	9	11	7	9	240	66	58	56	46
MEAN		92.6	23.1	16.1	16.8	19.5	228.9	74.1	55.5	64.0	60.3
STD DEV		18.0	7.3	5.0	4.9	6.5	59.9	13.4	7.7	11.6	11.3
8	11	183	23	29	27	23	347	71	72	58	56
8	12	113	26	9	12	16	339	46	24	38	32
8	13	91	26	23	18	18	294	49	63	49	47
8	14	106	26	21	17	17	296	38	52	54	42
8	15	113	21	17	16	18	418	28	29	36	22
8	16	131	30	17	13	25	244	40	34	34	36
8	17	88	26	17	17	16	157	36	35	36	33
MEAN		117.9	25.4	19.0	17.1	19.0	299.3	44.0	44.1	43.6	38.3
STD DEV		12.0	1.1	2.3	1.8	1.3	31.0	5.1	6.8	3.7	4.2
SEA MEAN		95.5	22.1	16.8	15.7	18.0	233.3	66.4	52.2	57.4	53.8
SEA STD DEV		24.5	7.7	5.6	5.7	7.0	72.7	18.6	11.5	15.7	15.6

(continued)

TABLE 16 (concluded)

INDICATOR		BOD$_5$ (MG/L)					COD (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
9	18	104	35	22	35	13	194	41	48	47	22
9	19	124	48	21	34	16	232	61	60	56	56
9	20	142	48	22	34	28	299	74	41	60	55
9	21	106	30	20	31	17	178	55	53	47	51
9	22	99	23	28	25	14	143	36	44	45	38
9	23	111	29	25	27	14	163	43	43	47	43
9	24	107	28	20	29	17	149	26	24	30	26
MEAN		113.3	34.4	22.6	30.7	17.0	194.0	48.0	44.7	47.4	41.6
STD DEV		14.9	9.9	2.9	3.9	5.1	55.2	16.3	11.3	9.5	13.6
10	1	149	31	30	28	17	298	31	41	49	51
10	2	108	47	22	19	15	123	37	52	41	44
10	3	119	48	24	26	13	208	35	39	31	37
10	4	125	24	29	27	12	211	31	52	31	29
10	5	100	28	22	25	12	148	32	34	27	29
10	6	96	34	23	26	14	154	45	41	43	32
10	7	103	34	29	28	23	117	39	43	38	34
10	8	72	29	18	25	13	161	61	49	49	45
10	9	67	21	19	16	12	182	40	22	30	28
10	10	94	26	18	17	7	170	18	54	30	28
10	11	115	16	23	22	9	234	30	34	36	34
10	12	128	21	30	24	6	236	24	34	34	24
10	13	122	31	30	23	15	176	26	28	21	24
10	14	131	31	20	22	13	255	32	38	22	28
10	15	88	19	17	16	12	331	40	59	37	40
10	16	147	22	21	20	16	252	36	29	39	49
10	17	94	49	31	20	11	296	97	75	34	27
10	18	141	49	26	23	12	214	38	34	28	20
10	19	97	24	19	18	11	191	32	36	34	25
10	20	81	18	15	[illegible]	7	161	39	38	44	33
10	21	81	19	24	[illegible]	9	112	31	39	27	39
10	22	93	13	15	13	6	169	35	31	27	20
10	23	77	10	14	14	6	116	41	37	23	26
10	24	85	11	17	15	7	241	25	44	21	25
10	25	98	14	21	17	9	183	31	23	29	37
10	26	84	17	25	13	9	177	33	35	33	31
10	27	92	15	21	14	18	153	31	43	29	27
10	28	76	20	20	17	8	251	34	40	42	20
10	29	87	17	21	15	10	265	27	39	27	33
10	30	98	15	16	16	8	212	19	33	14	20
MEAN		101.6	25.1	22.0	19.6	11.3	199.9	35.7	39.9	32.3	31.3
STD DEV		20.0	10.2	4.5	4.4	3.6	51.2	12.7	9.7	7.5	7.6
11	24	82	22	9	1	6	88	40	30	26	11
11	25	51	13	5	1	2	132	42	30	31	31
11	26	85	12	6	3	3	162	34	32	30	32
11	27	98	13	6	2	3	170	27	28	15	32
11	28	85	12	4	3	4	199	16	17	18	15
11	29	105	9	4	3	3	168	44	26	18	22
11	30	105	38	8	4	6	258	24	14	6	8
MEAN		87.3	17.0	6.0	2.4	3.9	168.1	32.4	25.3	20.6	21.6
STD DEV		7.0	3.6	.7	.4	.6	19.8	3.9	2.6	3.4	3.9
SEA MEAN		101.2	25.3	19.5	18.7	11.0	193.9	37.1	38.3	32.9	31.4
SEA STD DEV		21.7	11.6	7.3	9.2	5.4	56.1	14.5	11.8	11.4	11.0

TABLE 17. DAILY RESULTS FOR TSS AND VSS

INDICATOR SAMPLING MO	DY	TSS (MG/L) 1	2	3	4	5	VSS (MG/L) 1	2	3	4	5
12	13	120	9	5	11	9	110	9	4	9	9
12	14	132	12	5	7	7	122	7	4	5	6
12	15	166	7	9	7	4	107	5	4	4	3
12	16	115	5	3	4	2	93	5	3	4	2
12	17	133	6	6	4	2	97	6	6	3	2
12	18	108	2	4	3	3	94	2	4	3	2
12	19	(129)	(7)	(5)	(6)	(4)	(104)	(6)	(4)	(5)	(4)
MEAN		129.0	6.9	5.3	6.0	4.4	103.9	5.7	4.1	4.7	4.0
STD DEV		18.8	3.1	1.9	2.7	2.6	10.3	2.1	.9	2.1	2.6
1	3	106	5	3	4	2	100	5	3	4	2
1	4	132	4	4	4	2	106	4	4	3	2
1	5	136	3	3	5	2	110	3	3	3	2
1	6	110	5	3	4	7	94	4	3	3	7
1	7	210	8	8	6	6	166	4	4	3	4
1	8	94	6	5	4	3	78	5	4	4	3
1	9	106	5	3	6	2	88	5	3	6	2
1	10	86	4	3	4	3	70	4	3	3	3
1	11	98	4	3	2	3	80	3	2	1	2
1	12	110	6	3	4	2	90	6	3	4	2
1	13	90	4	4	3	2	78	4	3	3	2
1	14	140	5	2	3	3	105	3	1	2	2
1	15	84	3	2	3	2	68	2	2	3	2
1	16	80	3	1	1	2	71	3	1	1	2
1	17	118	(5)	2	2	2	98	(4)	1	1	2
1	18	120	6	4	3	3	102	4	2	3	2
1	19	132	4	3	2	3	110	4	2	2	2
1	20	91	5	3	4	3	79	5	3	4	3
1	21	104	6	4	4	4	84	6	3	4	3
1	22	127	6	2	2	4	109	6	2	2	3
1	23	112	3	7	4	3	90	3	7	4	3
1	24	83	7	3	3	2	65	7	3	3	2
1	25	91	4	4	2	3	76	4	3	2	3
1	26	62	6	3	2	3	58	5	2	2	3
1	27	140	4	6	4	4	122	3	4	3	3
1	28	146	4	6	2	2	112	4	4	2	2
1	29	92	6	6	3	2	75	4	4	2	2
1	30	184	7	6	3	2	115	6	5	3	2
1	31	155	6	4	4	2	97	5	4	3	1
2	1	109	7	4	3	1	88	7	4	3	1
MEAN		114.9	5.0	3.8	3.3	2.8	92.8	4.4	3.1	2.9	2.5
STD DEV		28.4	1.2	1.5	1.1	1.1	19.4	1.1	1.1	1.0	1.0
2	16	179	9	7	4	2	91	6	3	2	1
2	17	137	9	6	8	2	86	5	2	2	2
2	18	135	10	5	3	3	88	7	3	2	2
2	19	122	6	4	2	2	92	6	3	2	2
2	20	59	5	2	2	2	47	5	2	2	1
2	21	134	5	3	2	2	109	4	1	1	1
2	22	95	6	4	3	2	70	6	3	3	2
MEAN		123.0	7.1	4.4	3.4	2.1	83.3	5.6	2.4	2.0	1.6
STD DEV		14.0	.8	.6	.8	.1	7.3	.4	.3	.2	.2
SEA MEAN		118.5	5.7	4.1	3.8	3.0	93.0	4.8	3.1	3.0	2.6
SEA STD DEV		30.9	2.0	1.7	1.9	1.6	20.5	1.5	1.2	1.4	1.5

(continued)

TABLE 17 (continued)

INDICATOR SAMPLING		TSS (MG/L)					VSS (MG/L)				
MO	DY	1	2	3	4	5	1	2	3	4	5
3	13	83	19	24	30	38	44	15	13	17	16
3	14	41	19	29	25	17	33	14	15	18	10
3	15	55	25	40	33	32	45	24	19	22	20
3	16	52	30	34	24	26	42	28	25	22	18
3	17	39	24	31	27	26	33	24	25	23	20
3	18	40	21	26	25	24	32	21	20	20	15
3	19	25	16	18	22	21	21	15	15	18	18
MEAN		47.9	22.0	28.9	26.6	26.3	35.7	20.1	18.9	20.0	16.7
STD DEV		18.3	4.7	7.1	3.8	6.9	8.6	5.5	4.8	2.4	3.5
4	1	64	26	38	36	35	41	25	27	29	24
4	2	46	23	38	50	32	37	20	32	40	23
4	3	63	25	45	34	27	51	22	30	27	20
4	4	65	19	22	30	20	54	18	19	26	17
4	5	56	18	35	36	30	45	18	25	27	24
4	6	120	23	33	48	32	84	23	24	37	28
4	7	43	14	31	28	42	39	14	25	27	34
4	8	97	25	42	33	46	78	20	30	29	36
4	9	51	59	37	39	27	43	48	25	30	24
4	10	58	21	26	20	38	50	21	21	20	34
4	11	60	16	22	22	20	50	15	18	22	20
4	12	72	20	31	24	21	59	19	19	20	15
4	13	51	26	26	18	32	44	26	19	15	24
4	14	50	26	25	16	18	43	25	15	15	17
4	15	65	31	16	20	11	56	25	9	13	11
4	16	42	7	9	9	9	37	7	7	8	8
4	17	81	13	16	11	8	68	13	10	10	8
4	18	58	11	15	9	7	52	10	8	8	5
4	19	69	18	17	12	14	59	18	10	11	11
4	20	56	15	11	12	10	50	14	8	11	10
4	21	70	8	10	13	9	48	6	7	10	6
4	22	62	6	12	21	10	45	6	10	18	9
4	23	61	5	14	17	9	47	5	8	11	8
4	24	58	3	10	17	17	44	2	7	13	13
4	25	111	3	11	17	16	67	3	9	11	15
4	26	65	5	15	23	21	50	5	11	20	19
4	27	40	3	13	19	17	36	3	12	16	16
4	28	62	6	23	30	21	50	6	18	27	19
4	29	44	6	20	29	22	35	6	17	26	20
4	30	66	6	17	33	32	55	6	16	30	27
MEAN		63.5	16.2	22.7	24.2	21.8	50.6	15.0	16.5	20.2	18.2
STD DEV		16.6	10.6	9.6	9.8	9.8	10.5	9.0	7.1	8.0	7.6
5	8	67	15	39	39	53	59	15	35	29	32
5	9	84	14	36	40	44	70	14	36	30	32
5	10	75	15	47	50	39	63	14	36	39	27
5	11	65	20	49	53	46	53	20	41	40	32
5	12	52	21	52	57	80	43	20	39	33	32
5	13	45	22	70	80	65	34	20	32	40	31
5	14	57	28	74	80	58	43	24	47	50	31
MEAN		63.6	19.3	52.4	57.0	55.0	52.1	18.1	38.0	37.3	31.0
STD DEV		5.0	1.9	5.4	6.4	5.3	4.8	1.4	1.8	2.7	.7
SEA MEAN		61.0	17.6	28.4	29.8	27.8	48.5	16.3	20.3	22.9	20.0
SEA STD DEV		18.3	10.3	15.2	16.4	16.1	12.5	8.8	10.5	10.1	8.7

(continued)

TABLE 17 (continued)

INDICATOR SAMPLING		TSS (MG/L)					VSS (MG/L)				
MO	DY	1	2	3	4	5	1	2	3	4	5
6	21	114	8	13	19	13	94	8	9	13	9
6	22	104	16	17	16	34	86	16	11	15	16
6	23	103	25	16	15	13	91	24	13	11	9
6	24	112	29	20	18	17	90	23	10	11	11
6	25	81	18	13	17	14	69	17	11	13	10
6	26	79	23	12	17	11	56	19	8	10	7
6	27	106	24	17	18	31	86	24	10	14	25
MEAN		99.9	20.4	15.4	17.1	19.0	81.7	18.7	10.3	12.4	12.4
STD DEV		14.2	7.0	2.9	1.3	9.4	13.9	5.8	1.6	1.8	6.2
7	1	79	31	14	21	34	64	31	14	17	22
7	2	84	35	11	13	17	68	35	11	13	13
7	3	115	53	21	17	16	97	51	17	16	11
7	4	156	41	3	10	9	113	38	2	6	9
7	5	178	55	12	18	11	131	44	7	14	9
7	6	204	52	6	16	10	152	45	6	13	7
7	7	180	50	8	26	22	120	43	6	17	11
7	8	125	31	8	66	21	92	31	8	29	16
7	9	132	30	11	39	33	106	30	9	26	21
7	10	118	34	14	49	14	85	32	12	28	10
7	11	144	33	11	40	41	116	31	11	39	27
7	12	160	35	14	34	31	120	32	12	25	22
7	13	118	36	13	34	30	85	29	12	29	24
7	14	128	27	14	25	23	106	23	10	23	17
7	15	102	39	13	27	14	86	33	11	27	12
7	16	82	19	8	21	13	74	19	8	21	13
7	17	139	21	9	21	14	78	21	7	15	9
7	18	122	11	9	19	10	84	11	8	17	10
7	19	158	12	11	25	30	115	7	7	17	16
7	20	82	9	6	14	13	63	5	4	11	12
7	21	121	9	7	22	11	78	9	6	18	9
7	22	162	29	12	27	15	130	26	9	19	10
7	23	156	20	14	25	29	140	20	13	21	16
7	24	110	22	16	28	34	75	21	14	21	22
7	25	140	33	23	26	31	111	32	15	23	20
7	26	154	33	21	32	41	110	31	19	30	34
7	27	159	25	32	33	27	137	23	21	25	21
7	28	117	30	28	29	44	86	29	17	25	31
7	29	107	23	26	25	27	85	17	19	19	15
7	30	147	16	22	20	22	103	14	12	13	13
MEAN		132.6	29.8	13.9	26.7	22.9	100.3	27.1	10.9	20.6	16.1
STD DEV		27.9	11.3	6.3	10.2	9.3	21.5	10.2	4.2	6.2	6.2
8	11	334	17	27	30	14	234	17	25	24	13
8	12	139	11	21	20	13	120	11	18	18	11
8	13	101	11	30	19	14	70	9	20	19	14
8	14	178	6	15	26	14	131	6	13	22	14
8	15	193	9	15	22	14	146	9	14	20	12
8	16	188	16	19	26	23	131	10	10	17	12
8	17	148	11	21	30	21	86	8	13	20	13
MEAN		183.0	11.6	21.1	24.7	16.1	131.1	10.0	16.1	20.0	12.7
STD DEV		27.6	1.4	2.1	1.7	1.5	19.7	1.3	1.9	.9	.4
SEA MEAN		135.4	25.4	15.3	24.8	21.2	102.3	23.0	11.6	19.2	15.0
SEA STD DEV		45.0	12.8	6.7	10.1	9.7	31.8	11.7	4.8	6.5	6.4

(continued)

TABLE 17 (concluded)

INDICATOR		TSS (MG/L)					VSS (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
9	18	134	25	39	44	29	91	16	16	20	13
9	19	157	20	42	38	23	109	13	21	26	13
9	20	178	52	25	42	26	129	27	10	29	16
9	21	114	8	20	27	12	80	8	13	25	12
9	22	101	10	21	25	21	81	9	12	19	16
9	23	98	12	29	27	19	79	10	17	18	16
9	24	103	11	19	27	17	84	11	12	24	11
MEAN		126.4	19.7	27.9	32.9	21.0	93.3	13.4	14.4	23.0	13.9
STD DEV		31.1	15.5	9.3	8.2	5.7	18.9	6.6	3.8	4.1	2.1
10	1	166	4	15	20	11	136	4	9	11	7
10	2	104	7	18	22	7	81	6	8	8	6
10	3	122	7	25	16	11	95	5	14	12	9
10	4	188	11	74	31	26	149	10	34	18	18
10	5	90	7	26	22	15	86	7	17	16	12
10	6	77	7	23	19	21	65	7	13	14	18
10	7	70	5	23	14	15	54	4	14	11	9
10	8	71	9	13	13	14	56	8	8	9	10
10	9	91	2	11	12	6	72	1	6	7	5
10	10	121	2	11	11	6	83	2	8	7	4
10	11	132	2	10	9	8	103	2	6	5	4
10	12	90	2	11	7	6	73	1	6	4	3
10	13	102	3	10	10	6	83	2	6	6	5
10	14	159	5	11	8	6	122	3	4	3	2
10	15	76	3	9	8	5	63	3	6	4	3
10	16	120	2	9	9	9	92	2	8	8	7
10	17	151	38	21	6	6	93	27	14	3	3
10	18	149	7	9	8	4	105	5	6	4	1
10	19	139	7	14	10	8	94	5	8	6	6
10	20	93	12	14	11	9	68	9	11	8	7
10	21	117	7	13	11	10	87	6	11	8	7
10	22	91	4	8	5	5	73	4	7	3	4
10	23	65	4	7	4	2	50	3	6	3	2
10	24	111	1	11	5	5	91	1	9	3	5
10	25	138	4	9	7	5	110	4	8	6	5
10	26	116	2	7	5	4	102	2	7	5	4
10	27	105	2	8	11	5	69	2	6	8	4
10	28	82	6	20	6	4	57	4	13	3	2
10	29	121	5	14	6	7	88	4	9	6	5
10	30	163	5	6	6	4	124	4	6	5	4
MEAN		114.0	6.1	15.3	11.1	8.3	87.5	4.9	9.6	7.1	6.0
STD DEV		28.8	6.0	11.2	5.7	4.8	21.8	4.3	5.0	3.6	3.7
11	24	96	11	10	14	9	76	6	4	8	6
11	25	92	2	2	3	3	82	2	2	2	3
11	26	104	4	5	7	4	80	4	4	5	4
11	27	116	4	3	4	3	94	4	3	3	3
11	28	114	3	2	2	4	94	2	1	1	4
11	29	146	9	5	7	7	129	8	4	5	5
11	30	145	11	6	12	7	112	6	5	6	6
MEAN		116.1	6.3	4.7	7.0	5.3	95.3	4.6	3.3	4.3	4.4
STD DEV		8.2	1.5	1.1	1.7	.9	7.2	.8	.5	.9	.5
SEA MEAN		116.3	8.3	15.6	13.9	9.9	89.6	6.2	9.4	9.2	7.0
SEA STD DEV		30.3	9.5	12.7	10.5	7.0	22.6	5.7	5.8	7.2	4.7

TABLE 18. DAILY RESULTS FOR TKN AND AMMONIA NITROGEN

INDICATOR SAMPLING		T K N (MG/L)					NH3-N (MG/L)				
MO	DY	1	2	3	4	5	1	2	3	4	5
12	13	19.1	17.9	13.4	9.2	9.8	13.6	16.4	13.0	8.9	8.5
12	14	20.2	16.9	13.9	10.5	10.3	14.6	16.0	12.9	9.5	9.0
12	15	16.6	15.1	14.2	9.9	10.2	14.7	15.0	12.8	9.5	9.1
12	16	18.2	17.7	13.0	10.3	10.4	13.6	16.4	12.5	9.3	9.2
12	17	8.0	18.1	14.1	9.6	10.4	7.7	16.4	13.4	9.3	9.5
12	18	23.2	17.7	13.5	11.8	10.3	15.2	16.6	11.8	8.2	8.0
12	19	19.9	16.8	15.7	10.2	11.4	16.2	15.5	13.2	9.6	9.6
MEAN		17.9	17.2	14.0	10.2	10.4	13.7	16.0	12.8	9.2	9.0
STD DEV		4.8	1.0	.9	.8	.5	2.8	.6	.5	.5	.5
1	3	24.0	16.8	15.7	14.9	13.1	16.4	16.2	14.5	11.3	11.5
1	4	25.5	18.5	.0	12.6	11.7	19.1	17.3	14.5	11.4	11.5
1	5	28.0	18.8	15.7	12.8	13.0	20.6	17.6	13.2	11.4	10.5
1	6	19.7	19.0	15.1	12.7	12.7	13.8	17.8	14.8	11.8	12.0
1	7	24.9	19.0	15.9	13.2	12.7	15.4	17.8	13.4	11.6	11.9
1	8	21.2	18.9	10.2	12.3	12.7	17.6	17.7	9.6	12.0	12.2
1	9	26.4	19.3	16.4	12.9	12.7	22.2	18.2	15.0	12.2	11.5
1	10	19.9	19.5	19.7	12.8	13.5	15.6	18.2	15.1	11.4	12.3
1	11	21.6	20.4	15.6	13.4	14.0	16.9	17.6	15.5	12.4	12.7
1	12	23.2	18.8	16.6	13.2	22.1	18.4	17.9	16.0	12.6	12.7
1	13	19.6	19.1	15.8	13.6	14.2	14.6	18.0	14.2	12.4	12.3
1	14	18.9	24.8	14.8	13.9	14.2	14.7	17.8	15.0	12.8	12.5
1	15	21.9	17.1	19.8	13.0	14.3	16.2	15.8	17.8	13.0	12.6
1	16	19.2	19.3	16.0	13.9	14.6	14.5	17.8	15.4	12.7	12.6
1	17	21.4	18.2	21.2	14.6	14.4	15.0	18.0	19.8	13.2	11.8
1	18	23.1	26.1	17.3	16.7	18.2	15.1	18.0	16.4	13.3	13.6
1	19	27.5	17.2	3.0	12.6	16.2	19.4	15.6	2.6	11.9	13.6
1	20	20.2	19.2	18.5	11.2	16.2	15.4	17.3	16.5	10.6	13.6
1	21	20.7	19.9	11.9	15.4	15.7	15.5	17.6	11.8	13.5	13.9
1	22	19.3	15.3	13.2	13.8	16.2	16.1	14.7	12.6	12.4	13.9
1	23	21.6	17.2	17.4	12.8	16.9	18.8	16.3	12.2	12.2	14.5
1	24	19.4	16.9	15.4	14.2	16.4	15.1	15.7	13.7	12.9	14.4
1	25	15.0	16.1	12.1	13.9	16.8	13.2	15.3	11.1	12.3	14.7
1	26	20.1	15.8	15.6	15.2	15.9	17.6	15.5	14.9	14.1	13.9
1	27	13.8	17.9	16.6	14.6	16.1	11.9	16.0	14.7	12.9	14.9
1	28	18.5	17.3	16.5	15.3	16.1	13.7	16.2	14.8	14.0	14.4
1	29	17.9	17.5	16.0	15.3	15.4	14.0	16.7	15.4	14.8	14.7
1	30	23.4	17.5	18.2	15.2	16.2	15.4	16.8	13.0	14.3	14.0
1	31	22.9	10.2	10.4	15.1	17.3	15.3	4.9	5.9	11.3	15.2
2	1	21.3	12.0	10.3	.2	16.0	15.5	11.9	10.2	.1	14.5
MEAN		21.3	18.1	14.7	13.4	15.2	16.1	16.4	13.7	12.1	13.2
STD DEV		2.9	2.6	4.0	2.5	1.9	2.0	2.3	3.0	2.2	1.1
2	16	21.8	19.6	3.8	13.1	16.4	15.8	17.3	.1	7.1	14.8
2	17	18.8	19.2	16.9	15.1	17.0	12.7	17.8	15.0	12.2	14.5
2	18	16.7	19.7	17.9	15.3	16.7	12.1	17.6	16.0	13.6	14.7
2	19	15.0	18.9	18.0	15.3	16.9	10.8	17.0	16.0	14.0	15.0
2	20	14.0	18.7	18.0	14.9	14.6	10.2	16.6	15.7	13.0	14.5
2	21	18.3	19.1	5.9	15.3	16.5	12.3	16.4	.3	13.4	14.2
2	22	18.3	18.7	16.5	15.6	16.7	13.5	16.8	11.4	13.6	14.5
MEAN		17.6	19.1	13.9	14.9	16.4	12.5	17.1	10.6	12.4	14.6
STD DEV		1.0	.2	2.3	.3	.3	.7	.2	2.7	.9	.1
SEA MEAN		20.2	18.1	14.4	13.1	14.6	15.1	16.5	13.0	11.7	12.7
SEA STD DEV		3.8	2.5	4.4	2.7	2.6	2.7	2.2	4.0	2.5	2.0

(continued)

TABLE 18 (continued)

INDICATOR		T K N (MG/L)					NH3-N (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
3	13	10.7	14.5	14.9	13.0	15.8	6.4	11.6	10.3	8.5	12.1
3	14	11.0	13.9	14.8	14.0	14.7	7.8	11.4	11.2	10.8	11.9
3	15	3.5	1.8	1.3	1.0	14.1	3.4	1.7	.1	.1	12.1
3	16	3.3	1.1	3.5	1.3	12.1	3.2	.7	3.4	.1	11.5
3	17	5.0	5.0	5.8	4.1	13.6	4.9	4.9	5.7	4.0	11.2
3	18	7.3	6.6	3.1	1.3	13.4	7.2	6.5	3.0	.1	11.1
3	19	3.8	8.1	3.9	1.7	13.6	.1	8.0	3.8	1.6	10.9
MEAN		6.4	7.3	6.8	5.2	13.9	4.7	6.4	5.4	3.6	11.5
STD DEV		3.3	5.3	5.7	5.8	1.2	2.7	4.3	4.0	4.4	.5
4	1	11.2	8.9	5.6	4.3	11.5	7.2	7.8	5.5	4.2	7.4
4	2	3.6	7.1	6.8	3.0	10.5	.1	4.8	4.3	.1	6.6
4	3	10.5	9.5	9.9	9.1	10.0	8.2	8.2	6.3	5.9	6.4
4	4	11.4	10.3	9.9	6.1	9.8	8.4	8.0	6.4	4.6	6.8
4	5	12.3	10.2	5.7	3.8	8.9	9.3	8.8	5.6	3.7	7.0
4	6	12.2	10.4	6.8	2.4	9.5	7.8	8.6	6.1	1.9	6.8
4	7	10.4	10.0	7.2	3.8	7.9	7.8	8.5	7.1	3.7	6.2
4	8	10.5	10.2	9.1	2.9	7.4	8.3	8.2	6.4	2.8	5.8
4	9	10.6	6.1	7.8	2.7	8.0	8.2	6.0	6.0	1.2	5.3
4	10	10.1	10.1	8.4	4.5	8.3	7.2	7.7	5.8	2.7	4.5
4	11	12.3	10.4	6.9	4.8	7.2	8.6	8.1	5.3	1.7	4.8
4	12	14.5	10.3	7.7	4.0	7.2	9.8	7.9	5.8	1.6	4.5
4	13	12.0	10.2	7.2	2.8	7.4	7.2	7.9	5.4	1.1	4.6
4	14	9.6	10.0	7.2	3.0	7.0	7.4	7.8	5.2	1.2	3.7
4	15	11.0	11.2	7.6	2.6	6.3	8.4	9.0	5.0	.9	4.4
4	16	10.8	9.5	6.8	2.3	6.6	7.8	8.2	5.1	.6	4.1
4	17	14.4	9.8	6.8	2.6	6.0	9.1	8.2	4.8	1.0	3.8
4	18	11.7	10.3	7.0	2.5	5.7	9.3	8.0	4.6	1.0	3.7
4	19	16.3	11.9	6.7	2.9	6.5	10.4	9.2	4.4	.6	3.4
4	20	12.8	11.0	6.2	1.8	5.5	8.4	8.9	4.4	.3	3.3
4	21	13.0	11.1	6.2	2.2	6.1	8.2	9.2	4.2	.3	2.9
4	22	11.3	11.1	6.4	4.2	5.7	6.9	8.8	4.4	1.9	3.1
4	23	13.8	11.0	6.4	2.8	6.2	12.0	8.9	4.5	.8	3.1
4	24	10.4	10.8	6.1	2.4	5.8	7.5	8.6	4.2	.4	3.2
4	25	15.3	10.9	6.3	2.9	5.7	8.3	9.1	4.1	.6	3.2
4	26	11.0	11.3	6.7	2.7	6.3	7.0	8.9	4.5	.4	3.4
4	27	7.2	11.3	6.7	2.8	6.6	5.0	8.7	4.1	.4	3.3
4	28	9.5	11.3	6.7	3.0	6.9	6.0	8.7	4.3	.4	2.8
4	29	8.2	11.1	6.5	3.0	6.5	5.6	8.7	3.6	.4	2.8
4	30	10.9	10.7	6.4	3.4	4.8	6.7	8.6	5.2	.5	2.4
MEAN		11.3	10.3	7.1	3.4	7.3	7.7	8.3	5.1	1.6	4.5
STD DEV		2.2	1.1	1.0	1.3	1.5	1.8	.8	.8	1.3	1.4
5	8	13.3	11.7	8.7	5.2	7.3	7.6	8.3	3.8	1.3	1.1
5	9	12.1	11.6	6.9	5.3	5.7	7.9	8.8	3.2	.9	.9
5	10	15.2	11.3	8.0	5.3	5.6	9.6	8.3	3.0	.7	.8
5	11	12.3	11.4	7.8	4.7	5.3	7.1	8.1	2.8	.4	.6
5	12	11.9	16.0	7.5	4.7	5.1	7.3	7.4	2.6	.4	.5
5	13	10.0	11.0	7.7	5.2	5.0	6.6	7.0	2.3	.5	.4
5	14	11.6	10.2	7.4	5.3	6.1	7.3	7.0	2.5	.4	.6
MEAN		12.3	11.9	7.7	5.1	5.7	7.6	7.8	2.9	.7	.7
STD DEV		.6	.7	.2	.1	.3	.4	.3	.2	.1	.1
SEA MEAN		10.7	10.0	7.1	3.9	8.1	7.2	7.9	4.8	1.7	5.0
SEA STD DEV		3.1	2.7	2.3	2.6	3.0	2.3	1.9	1.9	2.2	3.4

(continued)

TABLE 18 (continued)

INDICATOR		T K N (MG/L)					NH3-N (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
6	21	23.9	19.5	13.0	7.6	6.9	16.6	16.5	10.6	4.6	4.2
6	22	20.1	19.4	13.0	6.6	7.2	13.9	16.2	10.5	4.4	4.2
6	23	10.2	19.0	13.2	7.0	7.2	10.1	16.6	10.5	4.7	4.6
6	24	16.9	19.4	12.7	7.1	7.1	11.1	16.1	10.6	4.7	4.0
6	25	14.2	18.7	13.2	9.8	7.9	9.4	15.7	10.8	7.3	4.9
6	26	14.7	18.5	13.0	7.6	8.1	10.3	15.0	10.4	5.0	5.2
6	27	19.7	17.6	12.7	7.1	8.5	12.8	14.1	9.8	4.7	5.1
MEAN		17.1	18.9	13.0	7.5	7.6	12.0	15.7	10.5	5.1	4.6
STD DEV		4.5	.7	.2	1.1	.6	2.6	9	.3	1.0	.5
7	1	10.6	19.1	13.2	8.5	9.7	7.3	13.7	10.0	4.7	5.3
7	2	15.2	13.2	13.2	7.5	9.3	9.8	13.0	10.4	4.3	5.0
7	3	16.8	18.5	13.4	6.8	8.7	16.2	11.8	9.6	3.4	6.0
7	4	24.5	17.4	12.9	7.1	6.7	16.1	11.5	9.2	3.4	4.3
7	5	33.4	17.7	13.1	6.2	7.9	23.8	12.2	9.7	3.0	4.8
7	6	34.1	17.3	12.3	5.3	7.6	21.8	11.9	9.4	2.4	5.0
7	7	25.0	18.8	12.3	4.7	8.4	18.1	13.1	9.2	2.0	5.4
7	8	16.8	18.9	12.9	9.8	9.1	11.0	13.4	10.0	5.6	5.8
7	9	14.5	17.2	11.6	6.5	9.0	10.0	12.8	9.0	3.3	5.2
7	10	16.4	16.8	13.2	7.2	8.2	9.4	11.5	10.2	3.2	5.3
7	11	18.2	19.5	13.1	6.4	8.4	10.5	14.6	10.2	2.6	4.4
7	12	22.4	18.2	12.7	5.3	7.6	14.1	13.8	10.4	1.8	4.6
7	13	15.4	18.1	13.4	4.9	7.2	9.8	13.9	10.6	1.3	3.6
7	14	18.6	18.3	13.2	4.7	7.3	11.8	13.8	10.3	1.4	3.9
7	15	14.2	17.5	12.8	4.8	5.8	8.2	12.9	9.8	1.2	3.0
7	16	13.8	17.2	12.0	4.6	6.0	7.8	13.8	10.2	.9	2.8
7	17	18.9	18.6	15.8	4.8	5.6	11.7	14.3	14.5	1.4	1.9
7	18	18.7	18.2	14.1	4.7	5.3	13.8	14.8	10.8	1.4	2.3
7	19	25.9	18.4	14.6	4.6	8.4	16.5	14.4	11.1	1.4	3.9
7	20	17.3	19.5	14.4	7.8	6.0	11.8	15.5	11.0	4.8	2.4
7	21	14.8	18.8	14.9	6.1	6.5	9.4	15.3	11.3	2.2	3.3
7	22	14.6	17.8	14.4	5.9	6.5	10.4	14.5	11.0	2.3	3.6
7	23	13.9	18.7	14.8	5.7	8.1	8.6	15.1	11.7	2.4	5.0
7	24	12.1	21.7	16.5	5.7	7.2	7.3	18.0	13.2	2.2	4.0
7	25	21.6	22.0	16.8	5.7	7.2	13.3	17.6	13.6	1.6	4.1
7	26	20.5	20.2	15.6	5.7	8.5	13.2	16.8	12.6	2.1	4.7
7	27	17.3	20.9	16.4	5.6	8.0	10.4	17.1	12.6	2.3	4.4
7	28	13.1	21.7	15.9	5.1	9.4	7.9	17.7	12.5	2.1	5.0
7	29	11.9	21.3	16.5	5.2	7.4	6.8	17.5	13.0	2.3	4.3
7	30	11.9	20.9	15.9	5.3	7.9	6.8	16.5	13.0	2.4	4.4
MEAN		18.1	18.7	14.1	5.9	7.6	11.8	14.4	11.0	2.5	4.3
STD DEV		5.2	1.6	1.4	1.1	1.1	3.8	1.7	1.3	1.0	.9
8	11	16.5	23.2	16.0	6.0	6.2	3.6	18.7	11.3	2.2	3.3
8	12	15.8	20.6	14.9	5.2	5.6	8.1	16.8	11.5	1.8	2.6
8	13	13.6	20.8	14.0	4.4	6.2	7.1	16.6	10.4	1.6	2.7
8	14	11.2	19.8	14.4	4.2	5.8	6.5	15.8	11.4	1.2	2.7
8	15	17.4	20.4	14.3	4.2	6.1	9.3	16.7	11.0	1.2	3.2
8	16	20.6	21.4	14.5	4.2	6.2	9.6	17.0	10.0	.8	2.8
8	17	10.1	22.0	14.2	4.4	5.9	5.0	18.1	10.2	.8	2.7
MEAN		15.0	21.2	14.6	4.7	6.0	7.0	17.1	10.8	1.4	2.9
STD DEV		1.4	.4	.3	.3	.1	.8	.4	.2	.2	.1
SEA MEAN		17.4	19.2	14.0	6.0	7.4	11.1	15.1	10.9	2.7	4.1
SEA STD DEV		5.4	1.8	1.4	1.4	1.2	4.1	2.0	1.3	1.5	1.0

(continued)

TABLE 18 (concluded)

INDICATOR		T K N (MG/L)					NH3-N (MG/L)				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
9	16	13.8	18.3	16.2	9.0	8.4	6.8	15.4	12.8	5.4	5.1
9	19	18.6	19.4	16.6	8.7	8.5	9.2	14.4	13.0	4.7	4.6
9	20	23.2	19.9	16.0	8.0	8.7	12.4	14.2	12.8	5.0	5.2
9	21	15.8	19.1	15.3	8.5	8.8	4.5	15.6	12.2	5.0	5.3
9	22	13.0	18.9	16.4	7.7	8.1	5.0	14.4	12.7	5.2	5.4
9	23	12.2	19.3	16.0	8.0	8.4	6.6	17.1	13.7	5.1	5.4
9	24	13.0	19.0	16.4	7.6	8.0	6.9	16.5	12.6	4.2	5.0
MEAN		15.7	19.1	16.1	8.2	8.4	7.3	15.4	12.8	4.9	5.1
STD DEV		4.0	.5	.4	.5	.3	2.7	1.1	.5	.4	.3
10	1	23.0	19.6	16.0	8.0	8.3	15.2	17.1	14.1	5.6	5.7
10	2	13.2	17.8	16.1	8.0	8.6	5.4	15.0	13.3	5.6	5.8
10	3	14.2	18.6	15.2	7.9	8.5	7.2	15.7	12.8	5.0	5.8
10	4	15.7	18.7	16.7	7.2	9.2	8.8	16.1	13.2	5.0	6.3
10	5	10.5	19.2	15.0	6.6	8.5	5.4	14.8	11.2	3.2	5.2
10	6	10.4	18.9	15.0	7.6	8.1	5.9	15.9	12.6	4.5	5.6
10	7	7.8	17.9	15.2	6.3	11.2	5.0	15.5	12.6	3.8	6.0
10	8	9.5	18.3	13.8	6.4	8.4	5.0	14.8	11.7	4.8	5.7
10	9	11.6	18.3	13.6	5.7	7.7	6.2	16.3	11.8	3.4	5.5
10	10	7.5	15.4	14.2	5.2	7.7	.9	12.9	11.7	3.9	6.0
10	11	9.9	16.1	14.6	5.4	9.4	8.9	13.4	11.7	3.4	7.3
10	12	11.3	15.5	13.4	5.4	8.4	4.4	12.9	10.2	3.2	3.4
10	13	6.3	1.0	1.2	1.3	1.6	1.2	.1	.1	.1	.1
10	14	8.4	16.8	14.2	5.4	7.6	2.7	13.6	10.7	2.6	4.1
10	15	5.0	12.2	14.7	4.2	8.1	1.6	9.5	11.8	2.0	5.7
10	16	10.1	17.2	14.8	5.2	8.1	4.5	13.8	11.2	3.1	5.2
10	17	14.4	19.2	17.6	5.2	7.8	6.9	13.6	13.8	3.1	6.9
10	18	12.0	15.8	14.0	5.1	8.5	4.3	13.2	11.9	3.0	6.1
10	19	4.4	15.9	14.1	4.9	8.3	.4	13.4	11.3	3.0	5.8
10	20	8.6	16.4	15.4	4.7	8.7	2.0	12.8	10.4	2.8	5.2
10	21	7.1	16.6	14.0	4.8	9.8	3.6	14.4	12.4	3.4	7.5
10	22	4.9	16.2	14.5	4.8	8.8	.6	14.2	11.6	3.0	6.4
10	23	4.4	16.2	14.2	4.9	8.8	.1	12.8	11.5	3.1	7.0
10	24	7.5	15.5	13.8	4.6	9.4	2.6	12.8	11.6	3.1	6.8
10	25	11.3	15.6	14.7	5.0	9.0	5.6	12.8	11.6	2.6	6.9
10	26	9.8	15.4	11.0	4.8	9.4	5.2	13.3	8.2	3.1	7.6
10	27	8.9	15.9	14.2	5.3	9.6	4.4	12.4	11.1	3.1	6.3
10	28	10.4	15.0	14.2	4.9	9.1	4.2	11.5	10.7	3.4	6.2
10	29	9.6	14.5	12.0	5.5	9.5	3.7	10.9	9.0	3.0	6.3
10	30	5.0	13.2	13.5	5.0	9.2	.1	8.0	7.7	2.6	7.7
MEAN		9.8	16.1	14.0	5.5	8.5	4.4	13.1	11.1	3.4	5.9
STD DEV		3.5	3.0	2.4	1.2	1.4	2.8	2.8	2.3	1.0	1.3
11	24	20.6	18.7	12.8	8.5	8.3	14.5	17.4	11.8	7.2	7.4
11	25	17.8	18.3	12.7	8.5	8.3	12.0	16.4	11.8	7.3	7.2
11	26	21.0	18.1	13.3	8.3	8.2	14.0	16.8	11.8	7.4	7.2
11	27	23.1	17.7	13.1	8.2	8.4	22.0	16.3	11.8	7.5	7.2
11	28	17.7	18.3	14.4	9.0	8.6	14.1	15.9	11.4	7.5	7.4
11	29	25.5	18.3	13.0	8.7	9.1	16.3	16.2	11.2	7.7	7.6
11	30	19.6	18.9	12.8	8.7	9.1	12.9	15.7	11.8	7.6	7.9
MEAN		20.8	18.3	13.2	8.6	8.6	15.1	16.4	11.7	7.5	7.4
STD DEV		1.1	.1	.2	.1	.1	1.2	.2	.1	.1	.1
SEA MEAN		12.4	16.9	14.2	6.4	8.5	6.6	14.0	11.5	4.3	6.0
SEA STD DEV		5.6	3.0	2.4	1.8	1.3	5.0	2.9	2.2	1.8	1.4

TABLE 19. DAILY RESULTS FOR NITRITE NITROGEN AND NITRATE NITROGEN

INDICATOR SAMPLING		NITRITE (NO2-N)MG/L					NITRATE (NO3-N) MG/L				
		1	2	3	4	5	1	2	3	4	5
MO	DY										
12.	13.	.04	.03	.04	.01	.12	<.1	.4	2.4	3.1	3.4
12.	14.	.01	.02	.01	<.01	.13	.4	<.1	2.3	3.2	2.9
12.	15.	.05	.05	.02	.01	.18	1.0	1.1	2.3	3.4	3.4
12.	16.	.02	.05	.02	.01	.13	<.1	<.1	2.4	3.2	3.4
12.	17.	.02	.04	.02	.03	.13	6.7	.3	2.4	3.7	3.5
12.	18.	.01	.13	.13	.15	.16	.8	.3	3.0	3.8	3.8
12.	19.	.05	.10	.03	.02	.12	<.1	.8	2.7	3.3	3.4
MEAN		.029	.060	.039	.034	.139	1.31	.44	2.50	3.39	3.40
STD.DEV.		.018	.040	.041	.052	.023	2.40	.37	.26	.27	.26
1.	3.	<.01	.13	.06	.07	.10	<.1	1.5	1.6	2.7	3.2
1.	4.	<.01	.21	.03	.08	.10	<.1	.3	1.8	2.8	3.0
1.	5.	<.01	.27	<.01	.07	.10	<.1	.1	1.7	2.8	2.8
1.	6.	<.01	.12	.06	.10	.10	.1	.1	1.9	2.8	2.9
1.	7.	.01	.17	.10	.09	.10	<.1	.1	2.5	3.3	3.0
1.	8.	.13	.09	.08	.06	.10	.6	.2	6.5	2.9	2.8
1.	9.	.01	.18	.06	.02	.08	<.1	.3	1.4	3.0	3.0
1.	10.	.00	.11	.09	.06	.10	<.1	.5	1.9	2.9	2.6
1.	11.	.02	.07	.06	.14	.09	.2	.3	1.4	2.9	3.0
1.	12.	.02	.24	.07	.11	.08	<.1	.4	1.6	2.8	3.0
1.	13.	.04	.12	.13	.10	.09	<.1	.3	2.8	2.8	2.6
1.	14.	.05	.13	.09	.02	.08	.1	.3	1.6	2.8	2.9
1.	15.	.03	.13	.18	.10	.09	.4	1.9	.2	2.8	2.6
1.	16.	.01	.19	.05	.11	.08	<.1	.6	1.5	2.8	2.7
1.	17.	.05	.33	.06	.13	.08	.5	.4	1.6	2.8	2.8
1.	18.	.03	.13	.03	.10	.08	<.1	.3	1.6	2.6	2.6
1.	19.	.08	.04	.13	.05	.09	.2	3.2	15.8	4.8	2.7
1.	20.	.04	.36	.02	.09	.08	.1	1.7	1.6	6.0	2.6
1.	21.	<.01	.06	.06	.03	.07	<.1	2.0	6.7	3.0	2.4
1.	22.	.01	.81	.06	.04	.08	<.1	4.0	5.6	3.9	2.6
1.	23.	.01	1.92	.08	.06	.06	.1	2.9	6.9	4.7	2.6
1.	24.	.03	1.23	.07	.03	.08	<.1	3.3	4.6	3.8	2.9
1.	25.	.03	1.18	.07	.05	.08	.5	3.9	7.3	4.4	2.7
1.	26.	.12	.71	.04	.01	.07	.3	3.6	3.0	2.2	2.4
1.	27.	.04	1.10	.04	.02	.06	.2	2.2	3.1	3.1	2.2
1.	28.	.03	.58	.04	.01	.07	<.1	2.8	2.9	2.7	2.3
1.	29.	<.01	1.15	.03	.02	.08	<.1	1.9	2.9	2.2	2.3
1.	30.	<.01	.50	.08	.02	.07	<.1	1.4	5.2	2.7	2.2
1.	31.	.09	.05	.07	.10	.08	.3	12.6	11.4	5.8	2.4
2.	1.	<.01	.05	.09	.02	.08	.3	5.4	6.8	15.7	2.2
MEAN		.032	.412	.068	.064	.084	.18	1.95	3.85	3.68	2.09
STD.DEV.		.030	.422	.032	.035	.010	.13	2.24	3.05	2.21	.25
2.	16.	.01	.07	.19	.04	.05	<.1	.5	16.8	9.5	1.6
2.	17.	.02	.06	.07	.05	.06	<.1	.5	2.0	3.8	1.6
2.	18.	<.01	.06	.02	.02	.05	.3	.3	1.8	3.2	1.7
2.	19.	.02	.06	.03	.12	.05	.2	.5	.9	2.2	1.4
2.	20.	.01	.05	.04	.01	.06	1.6	.6	1.1	3.6	1.7
2.	21.	.03	.08	.09	.04	.08	.2	1.0	16.1	2.0	1.2
2.	22.	<.01	.10	.15	.03	.09	<.1	.2	5.1	2.1	1.3
MEAN		.016	.069	.084	.044	.063	.37	.51	6.24	3.80	1.50
STD.DEV.		.003	.006	.024	.013	.006	.20	.10	2.65	.98	.07
SEA MEAN		.029	.301	.066	.056	.089	.39	1.48	4.02	3.65	2.61
SEA STD DEV		.029	.420	.043	.041	.027	1.01	2.17	4.00	2.25	.61

(continued)

TABLE 19 (continued)

INDICATOR	NITRITE (NO2-N) MG/L					NITRATE (NO3-N) MG/L				
SAMPLING	1	2	3	4	5	1	2	3	4	5
MO DY										
3. 13.	.34	.12	.11	.22	.08	1.5	.9	2.8	5.2	1.1
3. 14.	.30	.12	.10	.16	.09	1.6	.5	1.6	2.3	.9
3. 15.	.15	.08	.01	<.01	.14	3.8	10.4	13.0	13.2	1.2
3. 16.	.08	.06	.16	<.01	.45	4.3	11.4	10.1	12.6	1.4
3. 17.	.05	.04	.28	.12	.10	3.7	6.7	7.0	6.6	.6
3. 18.	.03	.03	.29	<.01	.13	.1	4.8	8.9	12.2	1.1
3. 19.	.05	.08	.28	.24	.11	9.0	3.5	7.9	9.8	1.2
MEAN	.143	.079	.176	.110	.157	3.43	5.46	7.33	9.13	1.10
STD.DEV.	.128	.035	.110	.101	.131	2.89	4.30	4.30	4.10	.20
4. 1.	.04	.02	.05	.09	.20	.4	1.2	3.0	4.6	1.1
4. 2.	<.01	.04	.01	<.01	.22	7.7	3.9	5.0	6.9	1.4
4. 3.	.15	.01	.05	.32	.20	<.1	.4	1.4	2.2	1.2
4. 4.	.25	.03	.14	.03	.20	.3	.4	1.4	3.2	1.4
4. 5.	.12	.11	.03	.09	.25	.2	.8	2.1	4.4	1.3
4. 6.	.07	.10	.10	.11	.23	.3	.4	1.7	5.6	1.4
4. 7.	.15	.03	.13	.52	.30	.5	.4	1.9	3.0	1.8
4. 8.	.25	.09	.06	.08	.24	.9	.4	1.4	4.2	1.2
4. 9.	.24	.35	.11	.10	.23	1.1	7.0	1.5	5.3	1.4
4. 10.	.25	.10	.25	.46	.23	1.5	.6	1.4	4.1	1.5
4. 11.	.15	.09	.27	.77	.24	.6	.5	1.4	1.5	4.6
4. 12.	.29	.08	.27	.71	.28	.9	.3	1.5	5.0	1.4
4. 13.	.22	.08	.30	.73	.27	1.8	.4	1.4	5.0	1.5
4. 14.	<.01	.08	.08	.58	.28	2.1	.5	1.5	4.7	1.6
4. 15.	<.01	<.01	.34	.09	.27	.9	.6	1.5	4.9	1.6
4. 16.	.01	.15	.54	.13	.26	.7	.5	1.9	5.3	1.4
4. 17.	<.01	.21	.74	.46	.24	.1	.6	2.1	4.7	1.4
4. 18.	.02	.29	.75	.47	.27	.4	.8	2.1	4.7	1.4
4. 19.	<.01	<.01	.78	.05	.34	.3	.5	2.5	4.6	1.3
4. 20.	.01	.28	.82	.28	.36	.6	.5	2.3	4.3	1.7
4. 21.	.01	.37	.78	.19	.46	<.1	.5	2.1	4.4	1.3
4. 22.	.01	.43	.73	.22	.47	.2	.7	2.3	2.6	1.3
4. 23.	.01	.47	.68	.40	.48	.2	.7	2.2	3.9	1.4
4. 24.	.12	.51	.61	.19	.49	.3	.7	2.3	3.5	1.5
4. 25.	<.01	.44	.45	.13	.42	<.1	1.0	2.4	4.4	1.3
4. 26.	.61	.40	.42	.13	.41	1.4	1.0	2.5	4.1	1.5
4. 27.	.01	.41	.42	.07	.44	2.4	1.1	2.5	4.5	1.4
4. 28.	.02	.38	.06	.11	.32	3.5	1.0	2.6	4.4	1.2
4. 29.	.26	.46	.38	.07	.32	2.4	1.0	2.7	4.2	1.5
4. 30.	.01	.41	.35	.09	.34	.4	1.2	3.0	4.2	1.5
MEAN	.112	.215	.357	.256	.309	1.11	.99	2.15	4.35	1.52
STD.DEV.	.124	.157	.245	.205	.082	1.35	1.17	.66	1.12	.57
5. 8.	.22	.02	.46	.32	.32	1.4	1.5	1.8	2.0	1.6
5. 9.	.04	.32	.58	.32	.37	2.0	.8	2.3	1.0	1.7
5. 10.	.02	.36	.59	.22	.36	.1	.8	2.6	2.8	1.6
5. 11.	.01	.36	.50	.16	.36	1.1	1.4	2.7	2.7	1.9
5. 12.	.02	.39	.45	.20	.31	.8	1.5	2.3	2.6	1.6
5. 13.	.02	.38	.41	.17	.35	2.8	1.5	2.6	2.4	1.7
5. 14.	.03	.04	.41	.04	.40	.7	1.8	2.5	2.7	1.6
MEAN	.051	.267	.486	.204	.353	1.27	1.33	2.40	2.31	1.70
STD.DEV.	.028	.061	.028	.036	.011	.34	.14	.11	.24	.03
SEA MEAN	.107	.201	.348	.225	.292	1.50	1.75	3.01	4.79	1.50
SEA STD DEV	.129	.167	.246	.202	.109	1.88	2.53	2.50	2.77	.57

(continued)

TABLE 19 (continued)

INDICATOR		NITRITE (NO2-N) MG/L					NITRATE (NO3-N) MG/L				
SAMPLING		1	2	3	4	5	1	2	3	4	5
MO	DY										
6.	21.	<.01	.22	.28	.36	.31	<.1	.9	.7	2.4	1.0
6.	22.	.01	.29	.40	.37	.34	.1	.7	.7	.8	.7
6.	23.	.09	.29	.52	.40	.34	.7	.7	.9	1.0	.6
6.	24.	.08	.31	.66	.43	.39	.2	.5	1.1	.8	.6
6.	25.	.09	.31	.76	.41	.43	.2	.7	1.1	.6	.7
6.	26.	.17	.41	1.01	.67	.42	.7	.6	1.6	1.0	1.1
6.	27.	<.01	.48	1.28	1.12	.46	<.1	.7	1.6	1.4	.6
MEAN		.066	.330	.701	.537	.384	.30	.69	1.10	1.14	.61
STD.DEV.		.060	.087	.350	.278	.056	.28	.12	.38	.61	.18
7.	1.	.01	.45	1.05	1.08	.59	4.7	.8	1.7	1.3	1.0
7.	2.	.03	.65	.97	1.28	.65	.9	1.2	1.4	1.7	.8
7.	3.	.19	.73	1.14	1.41	.73	.1	1.5	2.2	2.7	1.0
7.	4.	.03	.75	1.17	1.52	1.04	.3	1.3	2.2	3.0	1.6
7.	5.	.01	.70	1.06	1.36	1.06	.3	1.7	2.6	3.9	1.3
7.	6.	.03	.60	1.03	1.41	1.38	.3	1.6	2.6	4.8	1.9
7.	7.	.16	.58	1.08	1.18	.95	.7	1.3	2.4	4.6	1.3
7.	8.	.19	.42	1.04	.76	1.04	2.4	1.2	2.4	1.6	1.4
7.	9.	.09	.63	1.07	1.30	1.25	.7	1.9	2.8	3.6	1.6
7.	10.	.33	.99	.96	1.30	1.23	2.0	2.2	2.2	4.1	1.7
7.	11.	.28	.13	.88	1.27	2.09	.9	.3	2.1	4.0	2.6
7.	12.	.06	.36	1.07	1.31	1.87	<.1	.9	2.2	4.2	2.2
7.	13.	.54	.45	.78	.94	2.60	1.2	1.2	2.2	4.8	2.8
7.	14.	.75	.42	.82	.85	2.09	1.6	1.3	2.1	4.8	2.4
7.	15.	.22	.93	1.02	.64	3.12	.2	2.8	2.5	4.8	2.7
7.	16.	.28	.40	1.10	.67	2.86	.4	1.2	6.5	4.7	2.2
7.	17.	.03	.40	.64	.53	2.96	.5	1.0	1.7	5.0	3.3
7.	18.	.02	.42	.60	.51	2.64	1.5	1.6	1.7	3.8	2.6
7.	19.	.03	.40	.44	.37	2.18	<.1	1.5	2.0	4.4	2.5
7.	20.	.04	.50	.40	.89	2.65	.6	1.8	1.6	.5	3.0
7.	21.	.03	.61	.55	.50	2.38	1.6	2.7	1.7	4.1	2.9
7.	22.	.04	.04	.58	.52	2.16	2.5	4.0	2.4	4.2	2.5
7.	23.	.02	.91	.52	.45	1.31	2.0	3.4	2.4	4.4	1.8
7.	24.	.02	.13	.30	.43	1.79	6.0	.2	.4	4.5	2.4
7.	25.	.02	.02	.32	.46	1.74	.1	1.4	.6	4.6	3.1
7.	26.	.02	.03	.70	.46	1.88	1.3	2.6	2.6	5.1	2.7
7.	27.	.02	.83	.65	.42	1.97	1.2	1.4	1.9	4.8	2.2
7.	28.	.01	.02	.67	.43	1.82	1.9	1.4	1.9	4.9	2.6
7.	29.	.02	.55	.58	.37	1.76	5.1	1.0	1.8	5.1	2.5
7.	30.	.02	.59	.59	.41	1.76	4.6	1.5	1.7	5.0	2.6
MEAN		.118	.486	.793	.834	1.785	1.53	1.60	2.15	3.97	2.18
STD.DEV.		.156	.246	.241	.360	.635	1.44	.74	.98	1.10	.60
8.	11.	.01	.12	.62	1.38	1.53	.5	.8	1.8	5.4	2.8
8.	12.	.02	.38	.67	1.40	1.63	2.0	1.6	1.6	5.5	2.7
8.	13.	.02	.37	.81	1.42	1.71	.7	1.6	2.7	5.3	3.1
8.	14.	.03	.37	.74	1.00	1.94	3.2	1.5	2.3	5.6	3.5
8.	15.	.02	.36	.63	.98	1.69	2.2	1.4	2.4	5.6	3.1
8.	16.	.15	.31	.69	.74	1.90	.2	1.3	2.6	5.8	3.4
8.	17.	.93	.24	.73	.44	1.88	4.7	6.4	2.6	5.8	3.4
MEAN		.169	.307	.699	1.051	1.754	1.93	2.09	2.29	5.57	3.14
STD.DEV.		.127	.036	.025	.140	.058	.61	.72	.16	.07	.12
SEA	MEAN	.118	.434	.763	.822	1.557	1.40	1.53	2.00	3.77	2.12
SEA	STD DEV	.194	.243	.261	.401	.779	1.54	1.07	.93	1.66	.68

(continued)

TABLE 19 (concluded)

INDICATOR SAMPLING		NITRITE (NO2-N) MG/L					NITRATE (NO3-N) MG/L				
		1	2	3	4	5	1	2	3	4	5
MO	DY										
9.	18.	.08	.29	.02	.57	.62	3.7	2.0	1.1	3.5	2.4
9.	19.	.03	.03	.02	.61	.82	.1	1.9	1.1	3.1	2.6
9.	20.	.02	.03	.35	.66	.91	<.1	2.4	1.3	3.0	2.7
9.	21.	.08	.02	.03	.55	.94	1.8	1.7	1.4	3.4	2.9
9.	22.	.02	.01	.74	.02	.85	4.9	1.8	.9	3.6	3.0
9.	23.	.02	.16	.01	.91	.99	.8	1.8	1.7	3.7	3.0
9.	24.	.01	.18	.01	.93	1.05	4.4	1.6	1.8	4.2	3.3
MEAN		.037	.103	.169	.607	.883	2.26	1.89	1.33	3.50	2.84
STD.DEV.		.030	.108	.281	.302	.140	2.05	.26	.33	.40	.30
10.	1.	.01	.06	.28	.57	.77	1.3	.3	1.0	4.0	3.0
10.	2.	.03	.17	.62	.58	.64	4.5	2.9	1.7	3.8	3.0
10.	3.	.04	.12	.02	.64	.62	1.8	1.8	2.1	4.1	3.0
10.	4.	.01	.14	.73	.70	.50	<.1	1.7	2.2	4.6	2.8
10.	5.	.02	.12	.78	.65	.51	3.2	1.7	2.1	5.0	3.1
10.	6.	.01	.11	.79	.48	.58	6.5	1.7	1.8	4.7	2.4
10.	7.	.01	.10	.75	.40	.59	6.8	1.6	2.7	5.3	2.9
10.	8.	.03	.11	.62	.36	.53	6.8	1.0	2.4	5.1	3.0
10.	9.	.65	.11	.61	.33	.67	7.2	1.1	2.3	5.8	3.0
10.	10.	<.01	.25	.44	.34	.55	7.8	3.4	2.2	6.0	3.0
10.	11.	.01	.26	.52	.40	.50	.4	2.5	2.8	6.4	2.7
10.	12.	<.01	.36	.55	.48	.49	1.7	3.5	6.3	3.0	2.9
10.	13.	.01	<.01	<.01	<.01	<.01	10.7	17.8	15.3	10.5	9.4
10.	14.	<.01	<.01	.39	.44	1.23	2.7	2.3	2.8	6.5	3.5
10.	15.	.01	.02	<.01	.44	.79	10.9	7.2	2.7	7.6	3.2
10.	16.	.04	.31	.03	.42	.79	8.6	1.9	2.0	6.6	3.2
10.	17.	.02	.01	<.01	.40	.34	1.5	4.6	2.1	6.3	2.8
10.	18.	.02	.45	.04	.37	.57	6.9	3.1	2.4	6.2	2.6
10.	19.	.01	.68	.02	.39	.76	11.6	3.3	2.5	6.7	3.1
10.	20.	.21	.12	.18	.40	.60	8.8	2.5	2.3	6.9	2.6
10.	21.	.06	.23	.15	.41	.28	8.8	2.4	2.4	7.2	2.6
10.	22.	.01	.10	.10	.39	.67	10.2	2.4	2.6	7.3	3.0
10.	23.	.02	.26	.02	.41	.75	6.1	2.7	2.9	7.6	3.2
10.	24.	.01	.19	.16	.39	.58	7.0	2.9	2.8	7.7	3.1
10.	25.	.01	.14	.10	.40	.75	5.0	3.1	2.8	7.6	3.2
13.	26.	.01	.16	2.78	.47	.63	2.2	3.4	6.7	7.8	3.0
10.	27.	.02	.15	.10	.35	.92	5.6	3.0	2.8	7.6	3.3
10.	28.	.01	.11	.10	.45	1.04	4.5	3.4	2.6	7.5	3.5
10.	29.	.03	.27	1.32	.51	.78	7.6	3.2	4.5	7.6	3.5
10.	30.	.03	.69	.30	.51	.79	6.5	4.6	3.3	7.8	3.2
MEAN		.046	.194	.419	.436	.641	5.78	3.23	3.18	6.36	3.22
STD.DEV.		.109	.152	.498	.111	.202	2.94	2.73	2.31	1.43	1.07
11.	24.	.03	.08	.12	.17	.16	<.1	.3	3.4	5.7	4.0
11.	25.	.04	.08	.12	.15	.15	.3	.2	3.5	1.6	3.9
11.	26.	.03	.08	.16	.21	.15	<.1	.3	3.2	4.1	3.9
11.	27.	.06	.10	.15	.16	.17	.8	.2	3.2	3.8	4.0
11.	28.	.28	.10	.15	.17	.16	1.3	.3	3.2	3.8	4.0
11.	29.	<.01	.09	.14	.16	.16	<.1	.3	3.1	4.0	3.8
11.	30.	.04	.20	.14	.16	.16	.9	.3	3.2	3.8	4.0
MEAN		.070	.104	.140	.169	.159	.51	.27	3.26	3.86	3.94
STD.DEV.		.035	.016	.006	.007	.003	.18	.02	.05	.42	.03
SEA MEAN		.048	.165	.334	.421	.603	4.38	2.55	2.90	5.51	3.27
SEA STD DEV		.106	.152	.484	.198	.288	3.52	2.73	2.23	1.68	1.04

TABLE 20. DAILY RESULTS FOR TOTAL PHOSPHORUS AND FILTERED COD

INDICATOR SAMPLING		TOTAL P (MG/L)					FILTERED COD (MG/L)				
		1	2	3	4	5	1	2	3	4	5
MO	DY										
12	13	5.1	2.5	3.5	8.1	10.5	26	20	6	6	10
12	14	7.7	4.4	4.9	6.8	3.5	38	24	12	12	12
12	15	5.1	4.9	9.2	5.2	3.8	30	24	16	8	12
12	16	3.7	4.1	5.1	2.3	4.5	44	4	38	36	32
12	17	7.0	5.0	42.3	5.7	17.0	30	30	24	24	24
12	18	2.4	5.1	3.2	1.3	2.6	32	24	8	2	0
12	19	3.3	20.1	1.3	31.1	1.3	38	29	26	22	26
MEAN		4.90	6.57	9.93	8.93	6.17	34.0	22.1	18.6	15.7	16.6
STD DEV		1.94	6.03	14.48	10.92	5.60	6.2	8.7	11.4	12.1	11.1
1	3	7.7	7.7	11.7	12.8	5.5	35	29	27	27	23
1	4	6.7	3.7	7.0	13.3	8.6	40	38	36	42	40
1	5	3.9	5.9	15.3	4.5	16.1	62	56	44	36	36
1	6	18.4	5.1	5.1	5.8	13.4	40	48	36	30	26
1	7	9.6	62.5	9.3	6.6	5.6	46	38	38	26	36
1	8	15.3	5.5	7.9	3.1	7.6	46	28	30	28	22
1	9	15.0	6.3	17.8	7.0	16.9	54	46	42	38	43
1	10	9.7	5.4	4.0	4.1	6.7	54	44	38	36	36
1	11	5.3	7.3	7.0	5.3	6.4	44	48	46	44	8
1	12	5.6	8.5	7.4	13.5	5.0	54	49	46	41	36
1	13	8.0	11.1	4.3	6.7	8.5	50	41	38	34	36
1	14	9.0	5.2	5.0	5.3	5.5	54	40	31	26	31
1	15	8.0	3.9	7.9	6.8	7.7	40	49	35	35	45
1	16	7.4	5.3	6.8	12.6	9.3	32	28	28	28	19
1	17	5.7	5.8	4.8	8.3	3.6	37	19	32	28	41
1	18	5.3	5.3	21.4	5.3	5.0	43	39	30	30	30
1	19	8.0	7.3	8.5	7.3	5.1	30	43	43	43	35
1	20	5.4	4.7	7.0	6.5	4.1	45	57	41	45	57
1	21	8.4	4.2	5.4	5.3	4.2	53	49	45	53	45
1	22	2.8	5.4	6.6	5.3	4.1	43	51	35	43	47
1	23	.7	5.1	8.0	4.7	3.6	39	45	31	41	39
1	24	4.4	2.8	4.7	3.6	4.4	34	34	25	21	29
1	25	4.7	5.5	5.1	6.6	8.8	34	38	34	29	34
1	26	4.9	5.6	5.4	11.1	15.3	52	48	46	40	46
1	27	18.3	14.3	27.6	52.8	15.3	44	48	37	42	50
1	28	16.7	12.8	26.4	16.3	14.2	51	59	37	33	40
1	29	16.7	10.9	9.3	14.3	8.2	40	64	42	33	42
1	30	12.5	6.7	9.0	7.6	8.2	70	70	61	51	62
1	31	6.4	4.9	5.3	6.9	5.2	70	35	52	35	46
2	1	4.8	6.7	4.1	4.0	6.6	31	44	29	26	24
MEAN		8.51	8.38	9.17	9.11	7.96	45.6	44.2	37.8	35.5	36.8
STD DEV		4.30	9.47	5.65	8.07	3.64	9.4	9.9	7.2	7.1	10.2
2	16	7.6	6.9	4.9	6.1	6.9	55	34	34	45	40
2	17	6.2	5.8	4.9	4.9	7.8	51	38	35	28	24
2	18	5.2	6.5	6.5	3.5	4.9	49	48	37	32	32
2	19	3.9	7.9	4.5	4.2	6.2	28	23	22	17	17
2	20	3.8	5.8	3.1	3.9	5.2	34	39	27	22	26
2	21	2.9	4.0	4.2	4.9	6.8	52	38	35	32	32
2	22	5.6	5.6	4.3	6.4	4.3	27	29	24	24	26
MEAN		5.03	6.07	4.63	4.84	6.01	42.3	35.6	30.6	28.6	28.1
STD DEV		.60	.45	.38	.41	.47	4.5	3.0	2.3	3.4	2.7
SEA MEAN		7.38	7.71	8.57	8.40	7.36	43.2	39.3	33.6	31.2	32.2
SEA STD DEV		4.38	9.02	7.69	8.59	4.06	10.8	12.9	10.8	11.3	13.0

(continued)

TABLE 20 (continued)

INDICATOR SAMPLING MO	DY	TOTAL P (MG/L) 1	2	3	4	5	FILTERED COD (MG/L) 1	2	3	4	5
3	13	2.1	6.3	7.6	13.2	4.9	31	32	34	39	35
3	14	3.5	1.4	5.4	1.4	4.0	22	23	22	23	25
3	15	2.7	2.2	2.7	2.9	2.9	28	32	25	18	18
3	16	2.8	3.6	3.4	3.9	5.1	23	25	27	26	34
3	17	4.3	2.3	4.2	5.4	8.0	36	36	46	36	45
3	18	5.4	4.7	3.8	1.8	8.4	39	34	38	37	47
3	19	3.0	3.0	5.1	3.3	3.8	24	29	35	24	39
MEAN		3.40	3.36	4.60	5.34	5.30	29.0	30.1	32.4	29.0	34.7
STD DEV		1.12	1.39	1.62	3.55	2.11	6.6	4.7	8.3	8.2	10.4
4	1	4.1	5.5	4.2	3.9	5.5	31	42	32	31	42
4	2	.1	2.3	7.7	7.7	8.9	29	36	35	42	41
4	3	2.6	3.1	3.0	3.0	5.5	48	31	30	26	42
4	4	2.7	2.6	5.2	4.1	6.7	31	30	27	24	29
4	5	4.4	6.2	5.3	4.2	3.3	39	45	39	29	39
4	6	7.9	2.9	3.8	4.9	4.2	28	28	24	25	37
4	7	3.3	4.4	2.9	4.2	5.5	34	23	40	24	45
4	8	2.7	4.4	3.0	3.0	4.4	24	27	25	26	34
4	9	3.0	4.0	3.8	5.8	2.7	29	31	31	27	35
4	10	2.9	5.3	3.8	3.8	3.6	24	15	18	15	18
4	11	3.8	3.4	4.0	2.2	4.6	35	21	40	17	32
4	12	3.6	2.8	2.5	2.8	2.8	28	34	31	14	32
4	13	3.2	2.3	2.0	4.6	3.0	33	34	36	36	46
4	14	9.4	8.0	6.9	6.3	4.0	35	30	24	9	15
4	15	2.1	7.5	7.1	6.3	7.7	25	24	29	37	24
4	16	7.1	3.7	8.0	2.6	3.9	22	24	26	20	30
4	17	2.3	3.2	1.4	1.8	6.7	40	22	23	20	29
4	18	12.9	7.1	7.6	2.3	7.7	49	37	45	31	19
4	19	8.0	5.1	4.9	9.5	14.5	31	41	34	40	50
4	20	7.8	5.4	5.8	6.7	4.6	35	20	20	12	16
4	21	7.0	4.5	6.9	1.7	12.0	18	12	16	16	20
4	22	8.7	6.3	12.9	11.0	4.7	31	23	23	25	27
4	23	5.4	5.2	4.0	12.5	8.1	23	35	15	27	35
4	24	13.7	13.4	9.4	11.4	16.4	25	21	27	28	29
4	25	16.4	7.5	12.5	9.3	14.9	26	20	20	20	20
4	26	12.1	13.6	6.6	15.5	4.2	16	25	17	21	22
4	27	9.7	14.5	10.7	15.0	12.9	21	24	24	18	22
4	28	13.5	13.9	10.3	13.1	2.8	29	31	35	29	35
4	29	11.4	9.1	7.5	13.5	2.9	29	28	27	27	31
4	30	13.5	7.3	14.7	12.0	4.4	60	25	21	19	27
MEAN		6.91	6.50	6.28	5.86	6.44	30.9	28.0	27.9	24.5	30.8
STD DEV		3.93	3.18	3.05	3.77	3.52	8.4	7.0	7.0	7.2	8.5
5	8	2.9	9.1	4.7	8.1	5.6	23	23	20	19	25
5	9	11.7	7.2	12.9	10.6	2.9	25	24	21	20	29
5	10	9.5	5.6	2.9	7.0	5.1	29	29	20	16	31
5	11	2.6	5.9	2.9	4.0	4.0	29	12	22	19	27
5	12	2.7	4.2	4.4	3.8	1.2	22	27	34	20	29
5	13	2.1	4.6	4.9	4.3	4.2	29	29	29	27	39
5	14	4.5	2.6	1.3	2.2	3.0	25	25	26	26	29
MEAN		5.14	5.46	4.84	5.71	3.71	26.0	24.1	24.4	21.0	29.9
STD DEV		1.44	.83	1.41	1.10	.56	1.1	2.2	2.0	1.5	1.7
SEA MEAN		6.07	5.91	5.77	6.43	5.82	29.8	27.7	28.1	24.7	31.3
SEA STD DEV		4.16	3.22	3.27	3.91	3.51	8.3	7.2	7.7	7.8	9.0

(continued)

TABLE 20 (continued)

INDICATOR SAMPLING		TOTAL P (MG/L)					FILTERED COD (MG/L)				
MO	DY	1	2	3	4	5	1	2	3	4	5
6	21	12.6	3.4	17.3	11.0	9.3	45	31	32	38	32
6	22	9.8	6.3	10.3	9.8	6.3	28	14	13	8	12
6	23	18.6	8.0	12.1	10.9	8.9	80	37	37	23	25
6	24	6.7	3.2	3.9	1.9	3.1	27	33	31	33	41
6	25	6.7	4.3	5.0	5.1	6.7	20	18	23	21	22
6	26	5.0	3.9	7.8	4.8	5.1	26	40	39	29	42
6	27	6.7	7.6	7.1	3.9	3.2	32	32	16	4	14
MEAN		9.44	6.67	8.36	6.86	6.09	36.9	29.3	27.3	22.3	26.9
STD DEV		4.77	2.32	3.33	3.83	2.48	20.5	9.7	10.1	12.6	12.0
7	1	18.4	17.9	29.7	24.4	10.4	35	39	37	33	62
7	2	5.6	9.9	10.7	2.7	14.3	22	25	27	24	31
7	3	32.1	25.7	29.1	24.3	6.9	26	40	40	42	40
7	4	7.6	10.0	11.4	23.7	17.1	26	26	38	33	32
7	5	8.6	12.1	12.1	12.9	13.3	48	48	46	26	50
7	6	9.9	10.7	11.4	20.0	5.9	53	36	33	40	40
7	7	4.8	3.5	3.9	2.4	2.8	50	50	41	54	54
7	8	3.8	3.9	4.3	3.0	3.0	33	42	51	41	39
7	9	3.8	4.0	4.0	3.1	3.0	21	30	26	21	24
7	10	3.5	3.9	3.9	2.3	2.7	37	38	42	35	40
7	11	3.8	4.2	4.4	3.2	2.8	27	40	39	30	38
7	12	4.5	3.8	4.5	2.8	2.6	33	31	35	21	37
7	13	3.4	4.1	4.6	2.4	3.2	33	37	44	34	42
7	14	4.2	4.4	4.0	2.6	2.6	25	27	27	20	31
7	15	3.8	4.4	4.4	2.4	2.0	30	35	43	37	39
7	16	3.9	4.0	4.5	2.4	2.6	25	29	30	33	38
7	17	5.1	4.3	3.9	2.6	2.8	34	34	44	30	33
7	18	5.1	4.0	3.9	2.4	2.2	40	36	31	40	44
7	19	5.4	5.9	5.0	2.6	2.7	40	39	29	41	47
7	20	4.3	4.7	4.3	2.4	2.8	31	16	34	40	30
7	21	4.3	4.7	4.4	3.0	3.1	34	28	33	31	31
7	22	4.3	4.7	4.4	3.0	2.9	33	36	35	29	35
7	23	3.9	4.3	5.1	2.9	3.0	40	44	34	29	27
7	24	3.6	4.4	4.9	3.4	3.4	44	40	33	36	36
7	25	5.3	4.6	5.0	3.5	3.6	40	45	40	26	44
7	26	4.6	4.7	5.3	3.5	3.7	40	44	46	42	45
7	27	4.1	4.8	5.2	3.7	3.6	24	30	26	21	28
7	28	3.8	4.6	4.8	3.4	3.4	28	38	30	28	40
7	29	3.4	3.5	4.5	3.4	3.1	40	36	28	28	32
7	30	3.8	4.6	4.6	3.4	3.1	27	40	28	31	36
MEAN		6.09	6.34	7.07	5.93	4.62	34.0	36.0	35.7	32.5	38.2
STD DEV		5.13	4.38	5.86	6.40	3.48	7.5	6.7	6.2	7.1	7.4
8	11	6.1	4.8	4.9	3.1	3.1	32	42	34	26	40
8	12	4.5	4.2	4.4	3.2	3.2	12	15	12	10	16
8	13	4.4	4.9	4.4	3.2	3.1	24	30	39	27	24
8	14	4.5	4.7	4.7	3.0	2.8	16	28	26	28	18
8	15	4.6	4.7	4.7	3.2	3.0	8	12	14	14	12
8	16	5.2	4.9	4.9	3.1	2.8	14	22	18	10	12
8	17	4.1	4.9	4.5	3.2	3.2	19	24	17	13	12
MEAN		4.77	4.73	4.64	3.14	3.03	17.9	24.7	22.9	18.3	19.1
STD DEV		.25	.09	.08	.03	.06	3.0	3.7	3.9	3.1	3.8
SEA MEAN		6.41	6.14	6.89	5.63	4.60	31.9	33.1	32.3	28.6	33.3
SEA STD DEV		5.22	4.15	5.61	6.14	3.43	12.4	9.1	9.4	10.4	11.7

(continued)

TABLE 20 (concluded)

INDICATOR SAMPLING MO	DY	TOTAL P (MG/L) 1	2	3	4	5	FILTERED COD (MG/L) 1	2	3	4	5
9	18	3.9	4.5	5.1	3.5	3.4	6	18	16	12	14
9	19	4.7	4.4	4.9	3.5	3.7	29	37	23	21	27
9	20	5.5	4.5	4.6	3.5	3.5	23	21	23	32	23
9	21	4.3	4.3	4.5	3.7	3.7	37	33	22	18	31
9	22	3.8	4.2	4.8	3.7	3.7	12	27	16	17	24
9	23	3.7	4.3	4.6	3.6	3.6	23	27	12	16	17
9	24	3.6	4.2	4.7	3.7	3.5	12	20	9	8	16
MEAN		4.21	4.34	4.77	3.60	3.59	20.6	26.1	17.3	17.7	21.7
STD DEV		.68	.13	.20	.10	.12	10.5	7.0	5.6	7.6	6.3
10	1	5.3	4.1	4.1	4.0	3.9	27	24	27	31	29
10	2	4.9	4.1	4.1	3.9	4.1	16	21	17	17	21
10	3	4.9	4.5	4.5	4.2	4.0	23	21	17	14	12
10	4	4.7	4.0	4.6	4.0	4.1	19	21	17	12	12
10	5	4.0	4.2	4.2	4.2	4.1	13	15	13	16	12
10	6	3.8	4.2	4.1	4.1	4.0	9	19	19	17	17
10	7	3.7	4.3	4.5	4.1	4.2	11	23	22	14	6
10	8	3.7	4.1	4.1	4.2	4.2	31	37	29	18	24
10	9	4.1	4.2	3.9	3.7	3.7	20	24	12	6	6
10	10	4.5	3.9	3.9	3.9	3.9	22	14	12	14	14
10	11	4.5	3.9	4.0	3.9	4.0	22	18	20	12	14
10	12	3.9	3.7	3.9	3.5	3.9	6	10	24	18	12
10	13	3.8	3.8	3.8	4.4	4.0	20	10	9	18	12
10	14	5.2	4.3	4.2	4.2	3.9	24	16	12	17	14
10	15	5.4	4.1	4.1	4.2	4.1	29	35	35	27	24
10	16	4.2	3.9	3.9	4.2	3.9	20	11	18	33	29
10	17	5.2	4.2	3.9	4.2	4.2	36	25	29	25	20
10	18	5.4	4.2	3.9	4.3	4.1	20	25	18	14	18
10	19	3.8	3.8	3.8	3.5	3.9	18	19	18	20	20
10	20	3.8	3.9	3.8	4.1	3.8	18	27	31	27	23
10	21	3.5	3.6	3.7	3.9	3.8	10	18	18	6	11
10	22	3.5	3.8	4.0	4.1	4.1	13	17	22	12	9
10	23	4.2	4.1	4.0	4.1	4.1	11	22	23	18	22
10	24	4.6	3.9	3.8	4.1	4.1	6	19	15	10	14
10	25	4.1	4.0	4.0	4.1	4.0	12	15	16	18	16
10	26	4.5	3.8	3.6	3.8	4.1	21	29	25	17	15
10	27	4.1	3.8	3.7	4.0	4.3	19	29	24	24	18
10	28	3.5	3.8	3.8	4.0	4.0	16	20	17	29	17
10	29	4.1	3.7	3.8	3.8	3.8	16	22	20	20	29
10	30	4.6	3.9	3.7	4.0	4.1	23	16	21	14	16
MEAN		4.32	4.00	3.98	4.02	4.01	16.4	20.7	20.0	17.9	16.9
STD DEV		.53	.19	.22	.19	.13	6.4	5.8	5.5	6.1	5.6
11	24	9.8	5.2	7.7	9.2	3.8	30	26	8	20	17
11	25	9.7	8.0	6.4	6.4	10.5	42	38	32	27	36
11	26	9.4	9.0	9.4	3.8	10.3	24	28	22	28	22
11	27	10.5	11.8	9.2	8.1	9.4	55	19	17	8	4
11	28	4.7	11.3	6.4	4.2	4.5	34	29	17	10	11
11	29	8.0	8.9	5.3	3.2	3.2	66	28	16	16	16
11	30	11.4	6.4	5.1	5.3	6.2	14	20	6	2	4
MEAN		9.07	6.66	7.07	5.74	6.84	37.9	26.9	16.9	15.9	15.7
STD DEV		.82	.90	.65	.85	1.18	6.7	2.4	3.2	3.7	4.2
SEA MEAN		5.06	4.80	4.60	4.23	4.40	21.9	22.6	19.1	17.6	17.5
SEA STD DEV		2.02	1.93	1.37	1.10	1.61	12.0	7.0	6.5	7.3	7.3

TABLE 21. DAILY RESULTS FOR DO AND FECAL COLI AND FECAL STREPTOCOCCI

INDICATOR		D O (MG/L)					FEC COLI		FEC STREP	
SAMPLING		2	3	4	5		4	5	4	5
MO	DY						(NUMBER/100ML)			
12	13	10.2	12.6	14.2	14.2		10	10	10	10
12	14	10.6	12.4	12.8	12.8		40	10	10	10
12	15	10.4	12.2	12.4	12.4		50	10	40	10
12	16	10.2	12.8	14.6	14.6		50	10	20	10
12	17	10.3	12.6	14.8	14.8		90	10	20	10
12	18	11.0	13.0	14.8	14.8		20	10	40	10
12	19	11.2	13.2	15.0	15.0		40	10	20	10
MEAN		10.56	12.69	14.09	14.09	GEO M	35.6	10.0	20.0	10.0
STD DEV		.40	.34	1.05	1.05					
1	3	10.8	13.0	13.0	13.0		620	4	300	10
1	4	10.4	13.0	13.2	13.2		280	3	100	10
1	5	10.6	13.2	13.6	13.6		400	3	140	10
1	6	11.8	13.6	14.2	14.2		220	3	90	10
1	7	12.0	13.8	14.2	14.2		190	3	150	10
1	8	12.2	13.8	14.4	14.4		200	3	120	10
1	9	12.2	14.0	14.2	14.2		190	3	70	10
1	10	12.4	14.2	14.4	14.4		183	7	89	11
1	11	12.2	14.2	14.6	14.6		130	93	90	10
1	12	12.4	14.6	14.4	14.4		180	3	60	10
1	13	12.4	14.8	14.2	14.2		210	3	40	10
1	14	12.4	15.2	14.4	14.4		180	3	40	10
1	15	12.6	15.0	14.8	14.8		150	3	100	10
1	16	13.2	15.2	14.8	14.8		150	10	30	3
1	17	12.8	15.0	15.2	15.2		140	3	40	10
1	18	12.8	15.2	15.2	15.2		100	3	10	10
1	19	13.0	15.0	15.0	15.0		140	4	70	10
1	20	12.8	15.0	15.2	15.2		100	3	10	60
1	21	13.0	14.0	14.5	14.5		70	15	80	10
1	22	12.6	13.8	14.4	14.4		183	3	80	10
1	23	12.8	14.0	14.8	14.8		120	3	160	10
1	24	13.0	14.0	14.6	14.6		183	7	89	11
1	25	12.8	14.0	14.8	14.8		120	3	10	10
1	26	12.6	13.8	15.0	15.0		100	4	50	10
1	27	13.0	13.6	15.0	15.0		170	3	80	10
1	28	13.0	13.8	14.8	14.8		140	4	70	10
1	29	12.6	13.6	15.2	15.2		150	7	120	10
1	30	12.8	14.0	15.0	15.0		160	3	130	10
1	31	12.6	14.0	14.8	14.8		170	3	120	10
2	1	12.8	13.8	15.0	15.0		170	3	140	10
MEAN		12.42	14.14	14.56	14.56	GEO M	166.5	4.2	69.8	10.3
STD DEV		.63	.58	.49	.49					
2	16	12.8	14.8	15.2	15.2		20	3	10	10
2	17	12.6	15.0	15.0	15.0		10	3	10	10
2	18	12.8	15.0	15.2	15.2		40	9	30	10
2	19	12.8	14.8	14.8	14.8		10	3	30	10
2	20	13.0	15.0	15.0	15.0		10	240	30	10
2	21	12.8	15.0	15.2	15.2		10	7	20	10
2	22	12.8	15.0	15.0	15.0		50	3	10	3
MEAN		12.80	14.94	15.06	15.06	GEO M	16.9	7.4	17.7	8.4
STD DEV		.04	.04	.06	.06					
SEA MEAN		12.18	14.04	14.57	14.57	GEO M	90.5	5.3	46.0	9.9
SEA STD DEV		.94	.86	.66	.66					

(continued)

TABLE 21 (continued)

INDICATOR SAMPLING MO	DY	D O (MG/L) 2	3	4	5		FEC COLI 4	5	FEC STREP 4	5
							(NUMBER/100ML)			
3	13	10.4	12.6	13.9	13.9		300	230	110	20
3	14	11.6	13.6	14.8	14.8		170	43	30	50
3	15	11.8	13.6	14.4	14.4		40	290	90	10
3	16	11.4	13.4	14.4	14.4		1100	10	50	10
3	17	12.2	14.6	15.4	15.4		80	14	50	10
3	18	12.2	14.2	16.0	16.0		120	15	70	10
3	19	12.4	14.6	16.2	16.2		20	43	30	20
MEAN		11.71	13.80	15.01	15.01	GEO M	123.2	42.7	55.2	15.3
STD DEV		.68	.72	.87	.87					
4	1	9.2	9.6	10.6	10.6		148	6	6	2
4	2	11.0	11.7	11.4	11.4		148	6	6	2
4	3	10.2	11.2	11.7	11.7		148	6	6	2
4	4	10.6	12.3	12.6	12.6		130	5	4	2
4	5	10.2	12.2	12.8	12.8		170	8	8	8
4	6	9.8	11.8	12.4	12.4		170	2	8	2
4	7	10.0	11.2	12.8	12.8		920	13	6	6
4	8	8.6	10.8	12.0	12.0		350	8	7	4
4	9	9.4	10.6	12.2	12.2		79	8	4	2
4	10	8.9	10.3	11.2	11.2		540	2	6	1
4	11	9.5	10.8	11.0	11.0		70	13	3	1
4	12	10.0	10.8	11.0	11.0		240	5	13	2
4	13	10.2	11.0	11.2	11.2		110	13	7	3
4	14	10.6	11.2	11.4	11.4		5	2	1	0
4	15	9.0	9.5	9.5	9.5		49	2	9	2
4	16	8.0	9.4	8.8	8.8		49	2	7	0
4	17	6.0	7.2	7.4	7.4		13	2	5	1
4	18	6.1	7.7	8.1	8.1		8	5	2	0
4	19	7.0	8.2	8.1	8.1		11	2	3	2
4	20	6.2	8.3	9.0	9.0		13	2	3	0
4	21	6.7	8.6	9.4	9.4		8	2	13	0
4	22	6.9	8.6	9.2	9.2		33	2	4	0
4	23	6.8	9.4	9.2	9.2		23	2	2	1
4	24	6.7	9.4	9.3	9.3		17	8	7	5
4	25	7.4	10.2	9.6	9.6		49	23	19	15
4	26	8.2	10.6	10.2	10.2		33	8	3	3
4	27	8.6	10.4	10.4	10.4		33	2	1	0
4	28	7.9	10.0	10.4	10.4		79	5	2	0
4	29	8.0	10.2	10.2	10.2		34	2	1	1
4	30	8.1	10.2	10.0	10.0		22	2	3	0
MEAN		8.53	10.08	10.44	10.44	GEO M	55.2	4.2	4.4	1.8
STD DEV		1.36	1.19	1.32	1.32					
5	8	10.2	14.0	15.4	15.4		49	2	1	0
5	9	10.0	14.2	15.0	15.0		33	8	4	0
5	10	10.4	14.0	15.2	15.2		23	2	4	0
5	11	10.2	14.2	15.4	15.4		17	2	6	0
5	12	10.1	14.2	15.6	15.6		8	2	3	0
5	13	10.3	13.8	15.4	15.4		33	2	7	1
5	14	10.4	14.0	15.3	15.3		130	2	5	2
MEAN		10.23	14.06	15.33	15.33	GEO M	30.0	2.4	3.7	1.1
STD DEV		.06	.06	.07	.07					
SEA MEAN		9.30	11.30	11.94	11.94	GEO M	56.9	5.5	6.4	2.4
SEA STD DEV		1.77	2.14	2.56	2.56					

(continued)

TABLE 21 (continued)

INDICATOR SAMPLING		D O (MG/L)					FEC COLI		FEC STREP	
MO	DY	2	3	4	5		4	5	4	5
6	21	5.6	5.8	6.4	6.4		(NUMBER/100ML)			
6	22	5.2	5.4	5.8	5.8		8	2	8	3
6	23	5.4	5.8	6.2	6.2		8	2	4	1
6	24	5.8	6.4	7.9	7.9		2	2	3	2
6	25	6.7	7.6	8.6	8.6		2	2	3	1
6	26	7.7	8.0	9.0	9.0		2	2	2	1
6	27	7.6	7.9	9.1	9.1		33	2	4	2
MEAN		6.29	6.70	7.57	7.57		2	2	2	0
STD DEV		1.05	1.11	1.41	1.41	GEO M	4.4	2.0	3.3	1.4
7	1	9.8	8.8	8.8	8.8					
7	2	12.2	9.7	10.0	10.0		2	2	6	0
7	3	10.2	8.3	8.9	8.9		5	2	1	0
7	4	9.2	8.0	8.6	8.6		13	5	5	1
7	5	8.0	7.3	7.6	7.6		13	8	4	2
7	6	6.3	7.0	7.4	7.4		13	11	1	2
7	7	4.1	5.8	7.2	7.2		8	2	4	3
7	8	4.0	6.0	7.3	7.3		13	2	5	2
7	9	4.2	5.6	6.9	6.9		33	5	2	0
7	10	5.1	5.9	7.5	7.5		2	2	3	1
7	11	4.1	6.1	8.8	8.8		8	2	8	6
7	12	2.1	6.7	9.6	9.6		11	2	5	1
7	13	1.4	7.5	11.2	11.2		3	2	7	4
7	14	1.3	7.4	11.3	11.3		23	2	6	3
7	15	1.0	7.1	10.5	10.5		23	8	5	1
7	16	1.2	7.2	10.6	10.6		33	2	7	1
7	17	1.9	6.9	7.9	7.9		23	2	4	6
7	18	2.1	6.5	7.4	7.4		8	5	8	1
7	19	2.9	5.8	6.6	6.6		8	2	2	0
7	20	3.6	6.2	6.7	6.7		22	2	5	3
7	21	3.2	6.3	6.8	6.8		5	2	13	4
7	22	3.4	6.1	7.0	7.0		7	2	10	3
7	23	3.7	6.3	7.1	7.1		7	2	4	8
7	24	3.8	6.8	7.6	7.6		8	2	11	4
7	25	4.0	6.7	7.9	7.9		33	22	5	4
7	26	4.5	7.5	7.8	7.8		33	2	6	5
7	27	4.2	6.8	7.6	7.6		11	2	7	5
7	28	3.9	6.2	6.8	6.8		8	2	9	4
7	29	4.1	5.7	5.9	5.9		49	5	6	8
7	30	4.2	5.0	5.3	5.3		11	2	5	1
MEAN		4.46	6.77	8.02	8.02		11	2	5	6
STD DEV		2.52	.91	1.36	1.36	GEO M	11.1	2.8	4.9	2.4
8	11	1.6	8.0	9.1	9.1					
8	12	1.4	8.3	9.2	9.2		8	2	12	6
8	13	1.2	8.5	9.3	9.3		5	2	32	5
8	14	1.9	8.1	9.0	9.0		11	2	19	9
8	15	2.2	8.3	9.4	9.4		130	2	144	55
8	16	2.8	8.5	9.6	9.6		27	8	5	7
8	17	2.7	8.3	9.5	9.5		33	5	6	0
MEAN		1.97	8.29	9.30	9.30		11	2	8	5
STD DEV		.23	.07	.08	.08	GEO M	17.8	2.8	15.9	6.6
SEA MEAN		4.35	7.00	8.15	8.15	GEO M	10.4	2.7	5.5	2.6
SEA STD DEV		2.66	1.09	1.46	1.46					

(continued)

TABLE 21 (concluded)

INDICATOR		D O (MG/L)					FEC COLI		FEC STREP	
SAMPLING		2	3	4	5		4	5	4	5
MO	DY						(NUMBER/100ML)			
9	18	5.6	7.3	9.0	9.0		79	2	5	4
9	19	5.3	7.1	8.9	8.9		33	17	7	13
9	20	5.3	6.8	8.3	8.3		130	49	61	84
9	21	5.1	6.7	8.1	8.1		79	2	14	1
9	22	5.6	6.9	8.7	8.7		49	2	9	13
9	23	6.2	7.2	8.9	8.9		32	2	3	0
9	24	6.1	7.0	8.8	8.8		79	2	90	1
MEAN		5.60	7.00	8.67	8.67	GEO M	61.5	4.3	13.3	4.8
STD DEV		.42	.22	.34	.34					
10	1	5.2	6.9	8.3	8.3		33	2	53	1
10	2	5.1	7.0	8.5	8.5		79	2	19	0
10	3	5.1	6.8	8.2	8.2		46	2	55	0
10	4	5.2	6.9	8.4	8.4		110	2	34	0
10	5	5.4	7.3	8.7	8.7		33	2	30	2
10	6	5.0	7.2	8.6	8.6		43	2	27	0
10	7	4.8	7.0	8.3	8.3		17	2	7	0
10	8	5.1	7.1	8.5	8.5		22	2	11	0
10	9	4.9	7.2	8.6	8.6		49	2	4	0
10	10	5.0	7.0	8.7	8.7		49	2	1	0
10	11	5.2	7.2	8.6	8.6		33	2	9	1
10	12	5.1	7.4	8.7	8.7		31	2	8	0
10	13	5.0	7.7	8.5	8.5		49	2	4	2
10	14	6.1	8.0	8.6	8.6		17	2	6	1
10	15	6.2	7.9	8.7	8.7		17	3	11	0
10	16	6.5	8.2	8.7	8.7		17	2	14	0
10	17	6.6	8.5	8.9	8.9		17	2	11	1
10	18	6.3	8.6	9.0	9.0		17	2	0	0
10	19	6.2	8.4	8.9	8.8		21	2	2	0
10	20	6.4	8.5	9.2	9.2		26	2	2	4
10	21	6.3	8.6	9.1	9.1		130	2	2	0
10	22	6.4	8.7	9.3	9.3		33	2	1	1
10	23	6.2	8.4	9.2	9.2		22	17	3	1
10	24	6.1	8.5	9.5	9.5		23	17	5	1
10	25	6.3	8.2	9.4	9.4		14	2	5	1
10	26	6.2	8.9	9.7	9.7		49	2	4	0
10	27	6.5	8.8	9.6	9.6		17	2	2	0
10	28	6.4	8.9	10.2	10.2		17	2	2	0
10	29	7.6	9.4	10.3	10.3		17	2	3	0
10	30	7.5	9.2	9.9	9.9		17	2	7	0
MEAN		5.86	7.95	8.96	8.96	GEO M	29.1	2.3	6.0	1.1
STD DEV		.69	.72	.50	.51					
11	24	8.4	11.2	12.3	12.2		10	10	10	10
11	25	8.5	11.4	12.4	12.4		10	10	10	10
11	26	8.6	11.6	12.4	12.4		10	10	10	10
11	27	8.5	11.6	12.5	12.4		10	10	10	10
11	28	8.4	11.6	12.4	12.4		20	10	10	10
11	29	8.6	11.6	12.4	12.4		20	10	10	10
11	30	9.0	11.8	12.5	12.4		90	80	10	10
MEAN		8.57	11.54	12.41	12.37	GEO M	16.7	13.5	10.0	10.0
STD DEV		.08	.07	.03	.03					
SEA MEAN		6.25	8.37	9.46	9.45	GEO M	30.0	3.4	7.4	2.0
SEA STD DEV		1.22	1.58	1.39	1.37					

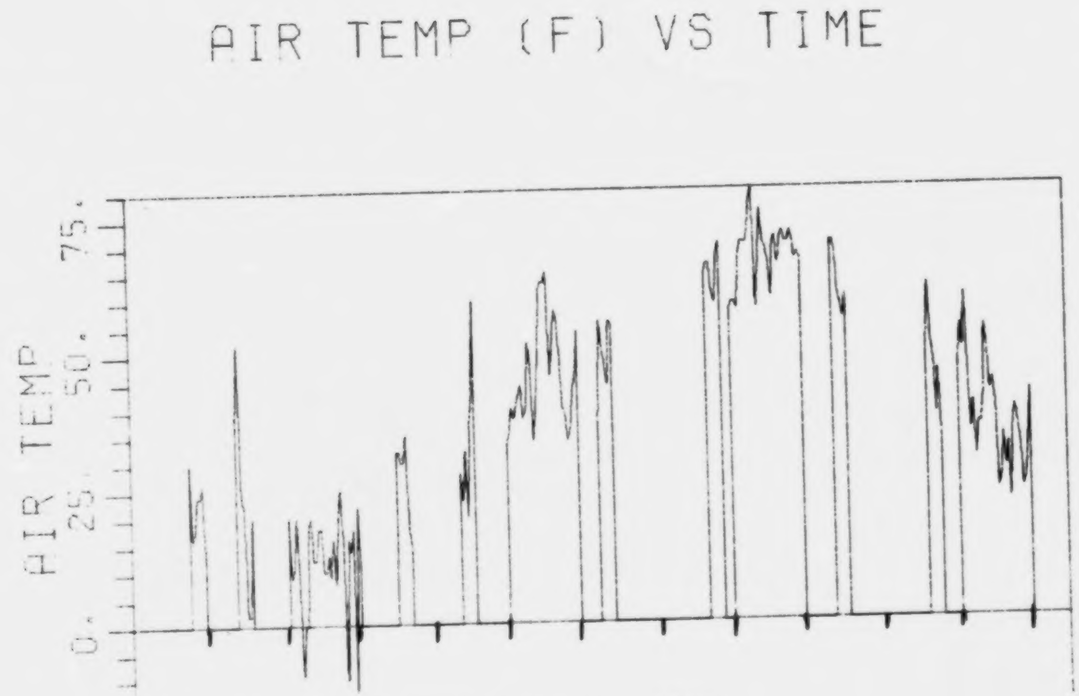

Fig. 33. Air temperature vs. time.

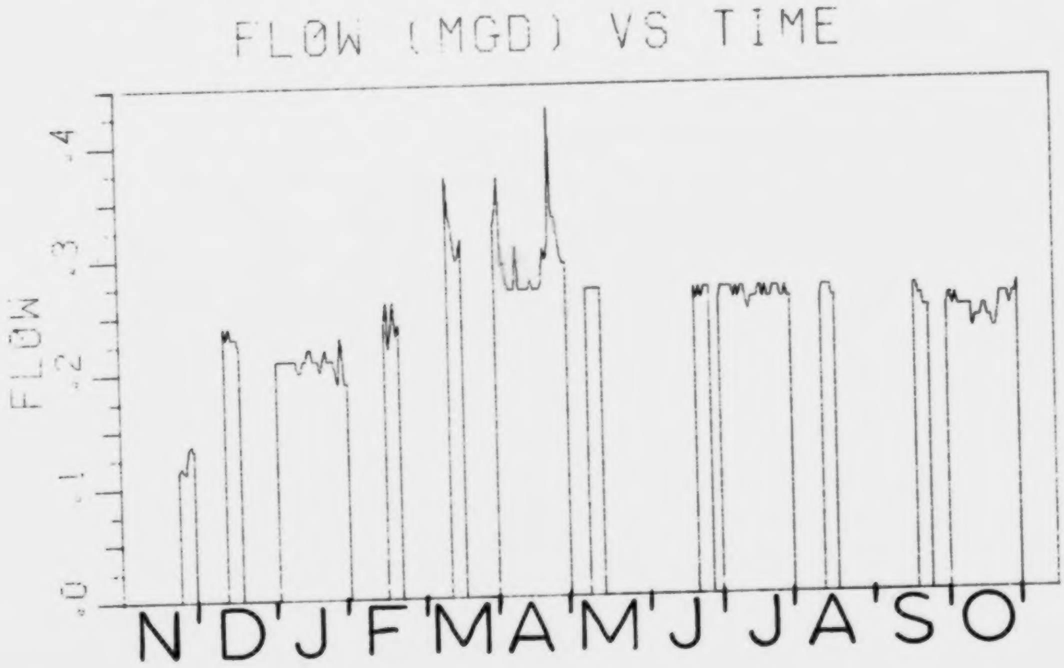

Fig. 34. Influent flow vs. time.

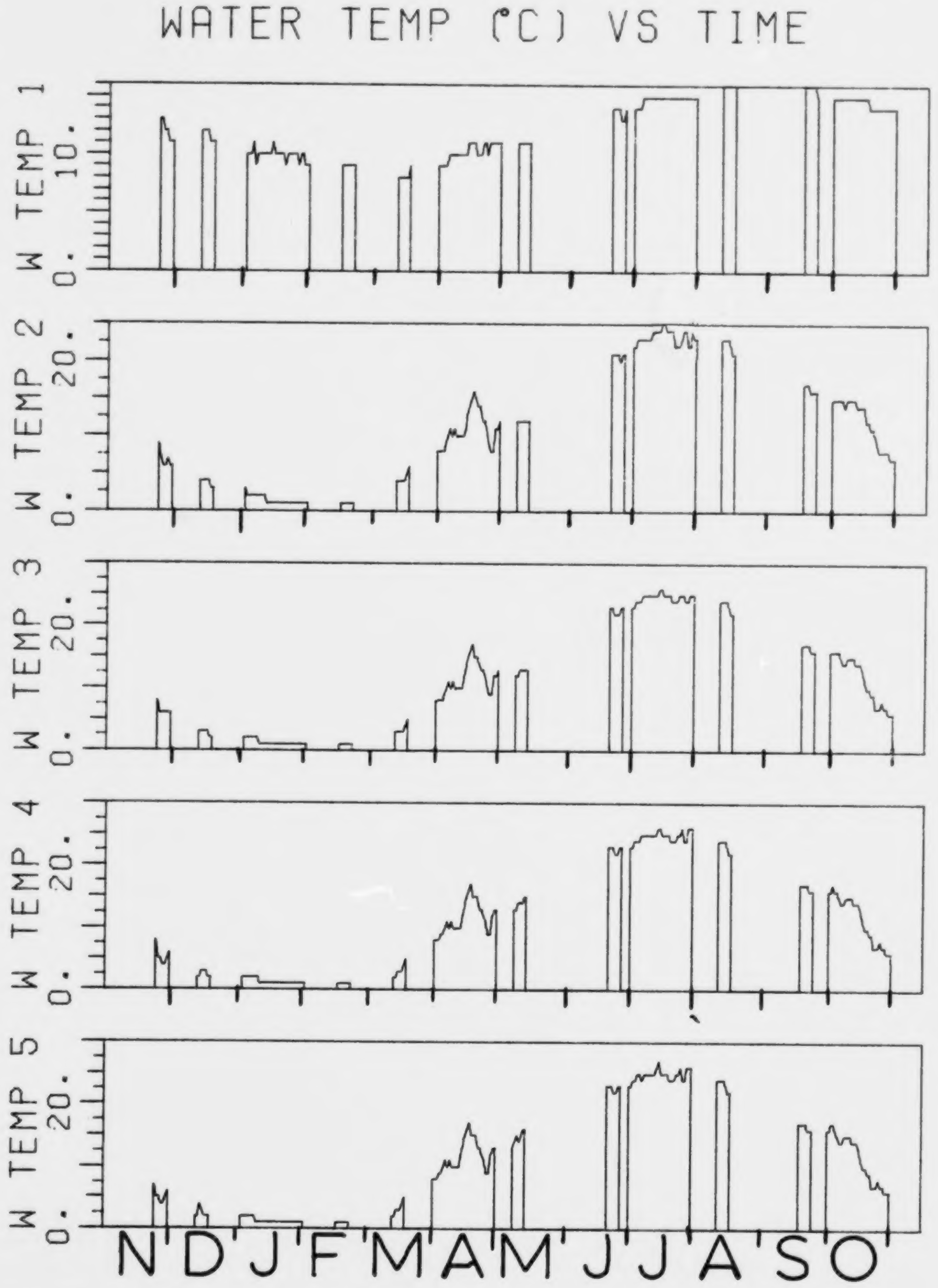

Fig. 35. Water temperature vs. time for all sampling points.

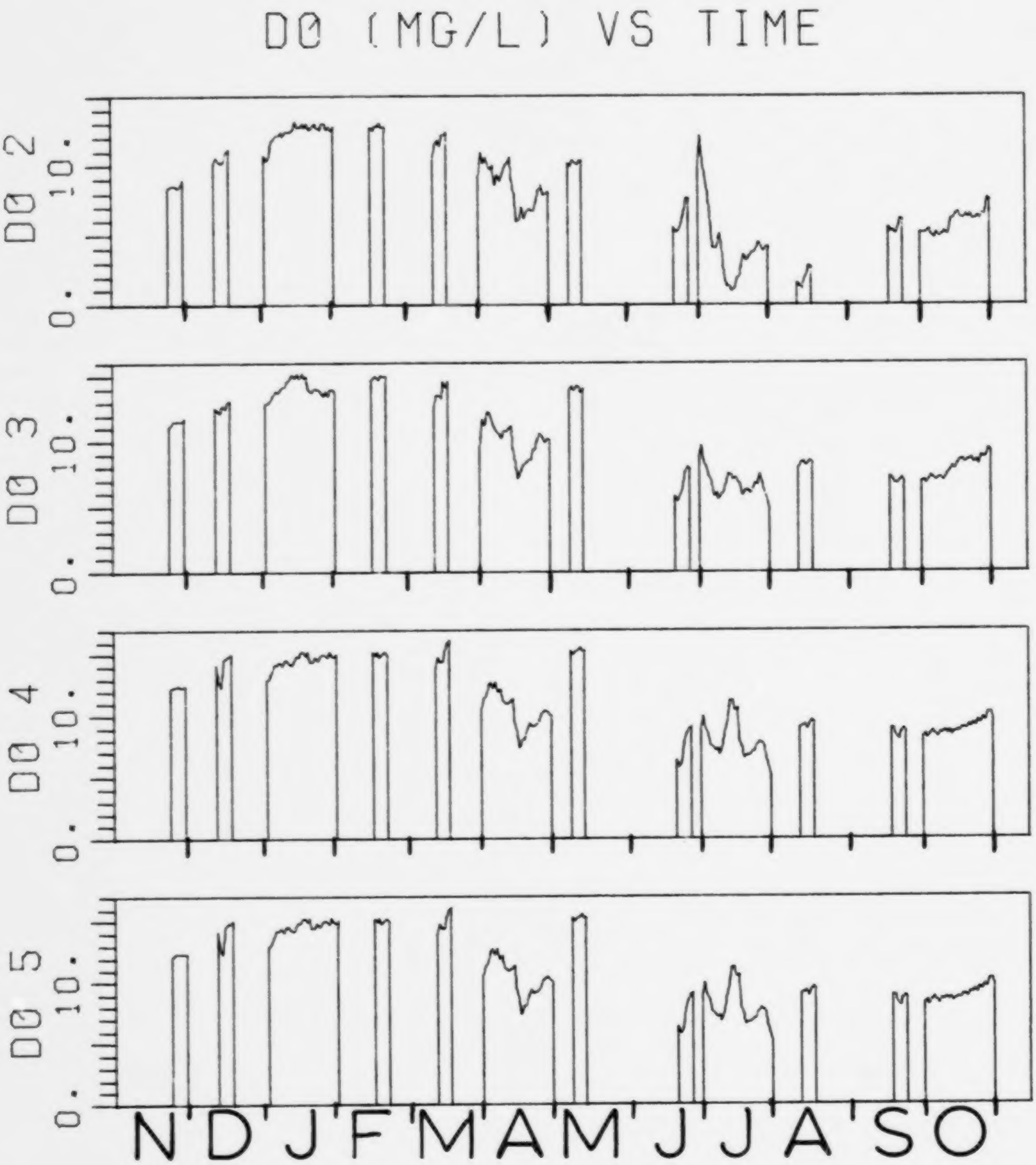

Fig. 36. Dissolved oxygen vs. time for sampling points 2-5.

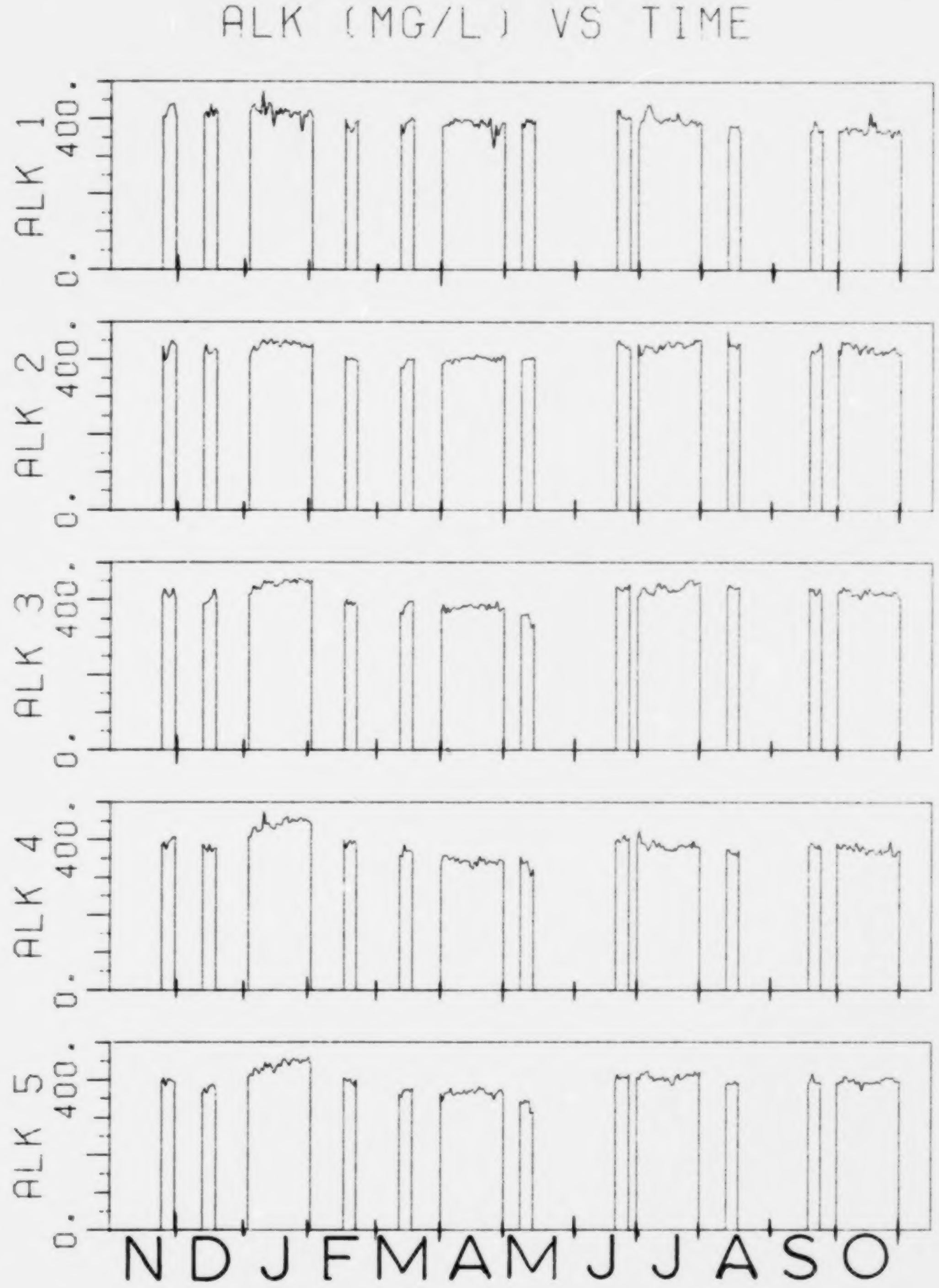

Fig. 37. Alkalinity vs. time for all sampling points.

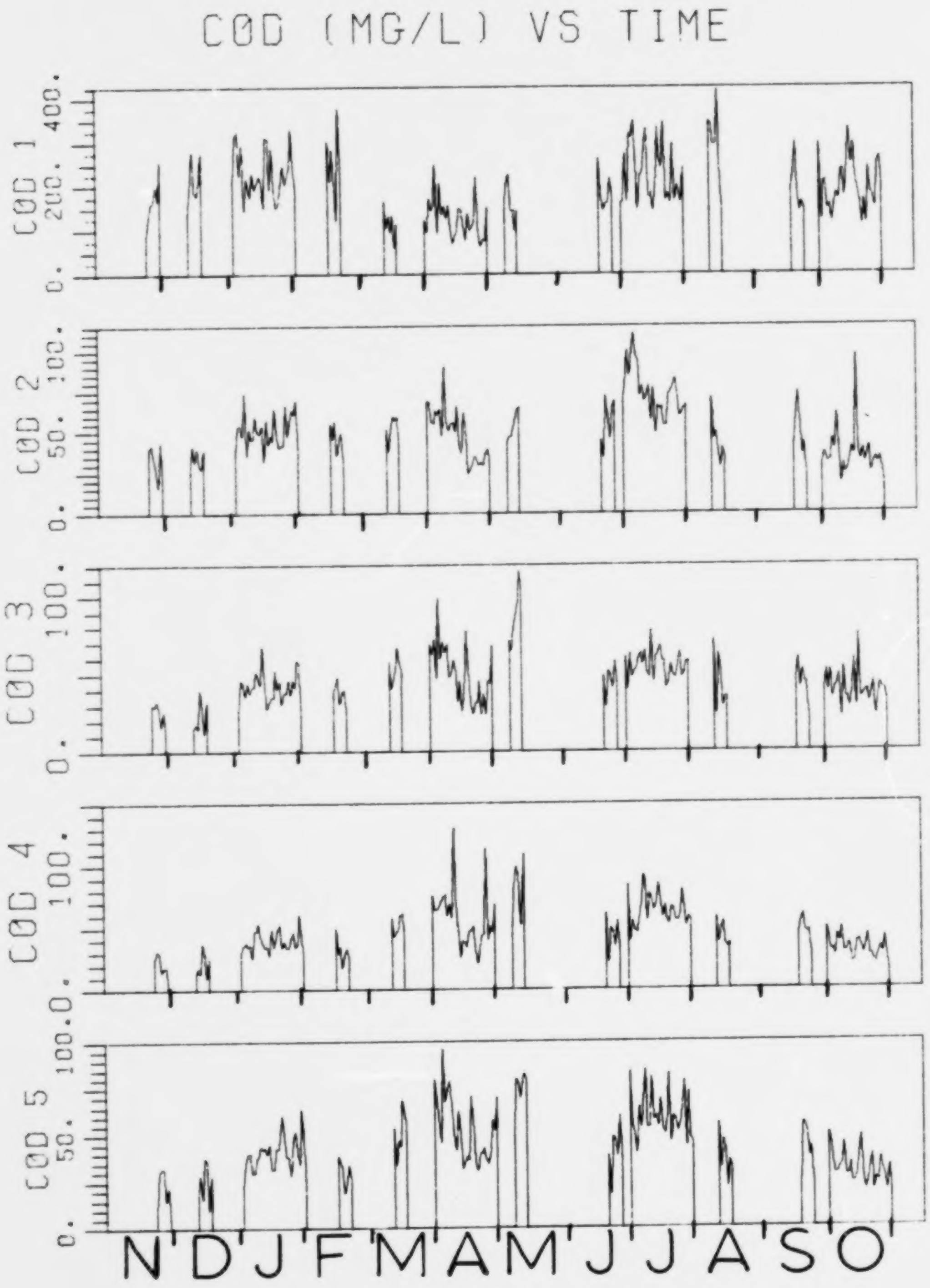

Fig. 38. Chemical oxygen demand vs. time for all sampling points.

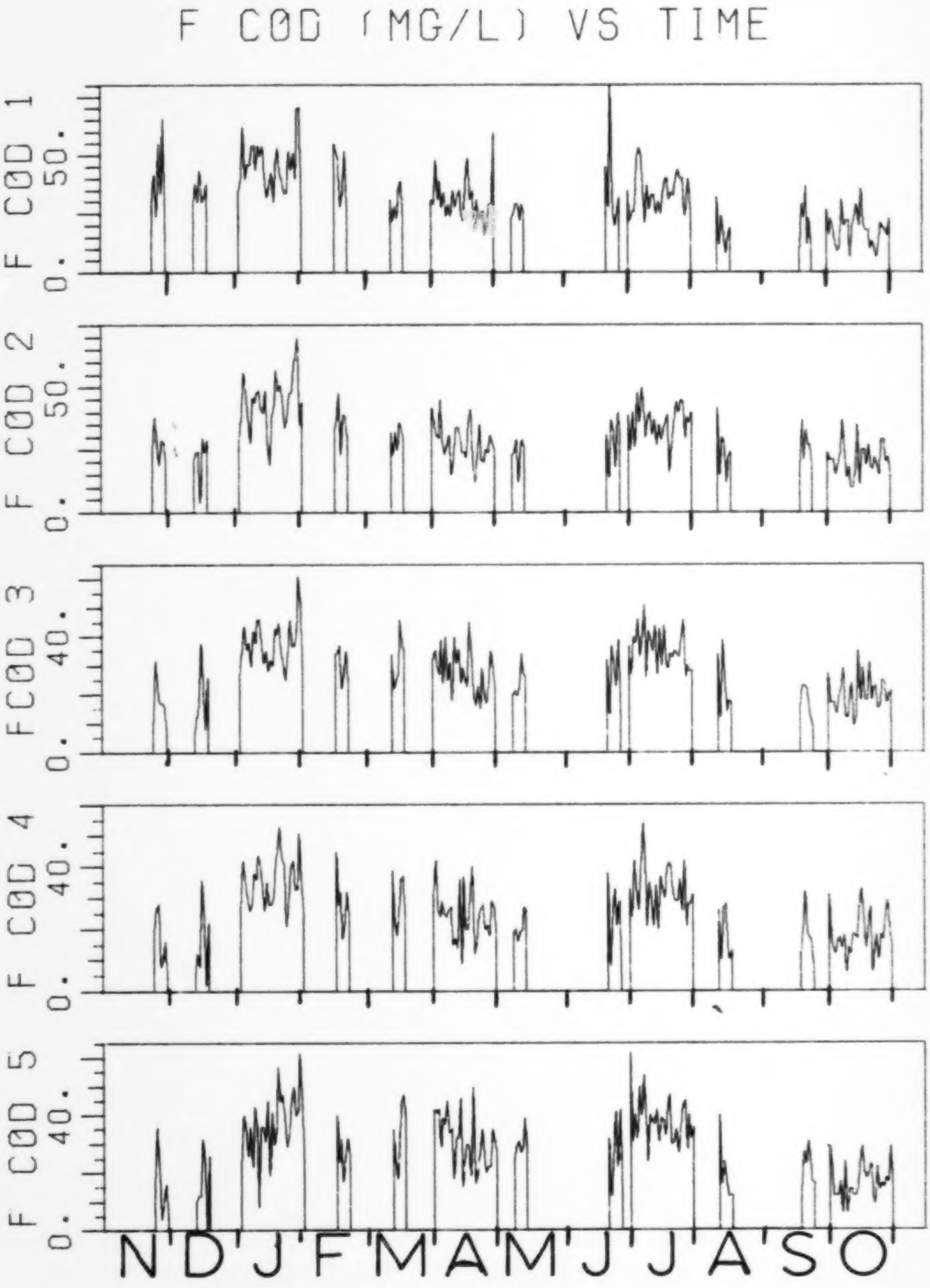

Fig. 39. Filtered chemical oxygen demand vs. time for all sampling points.

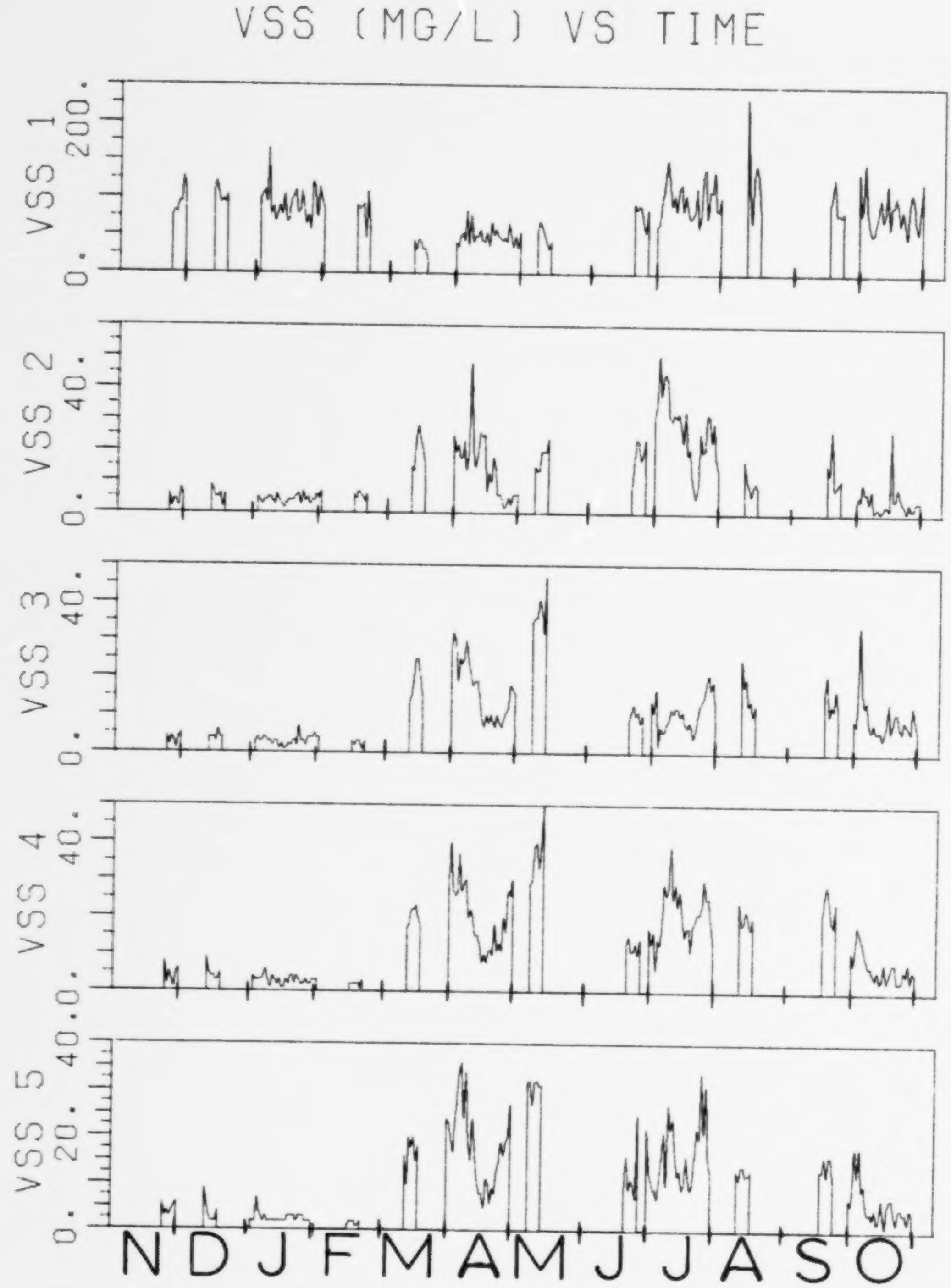

Fig. 40. Volatile suspended solids vs. time for all sampling points.

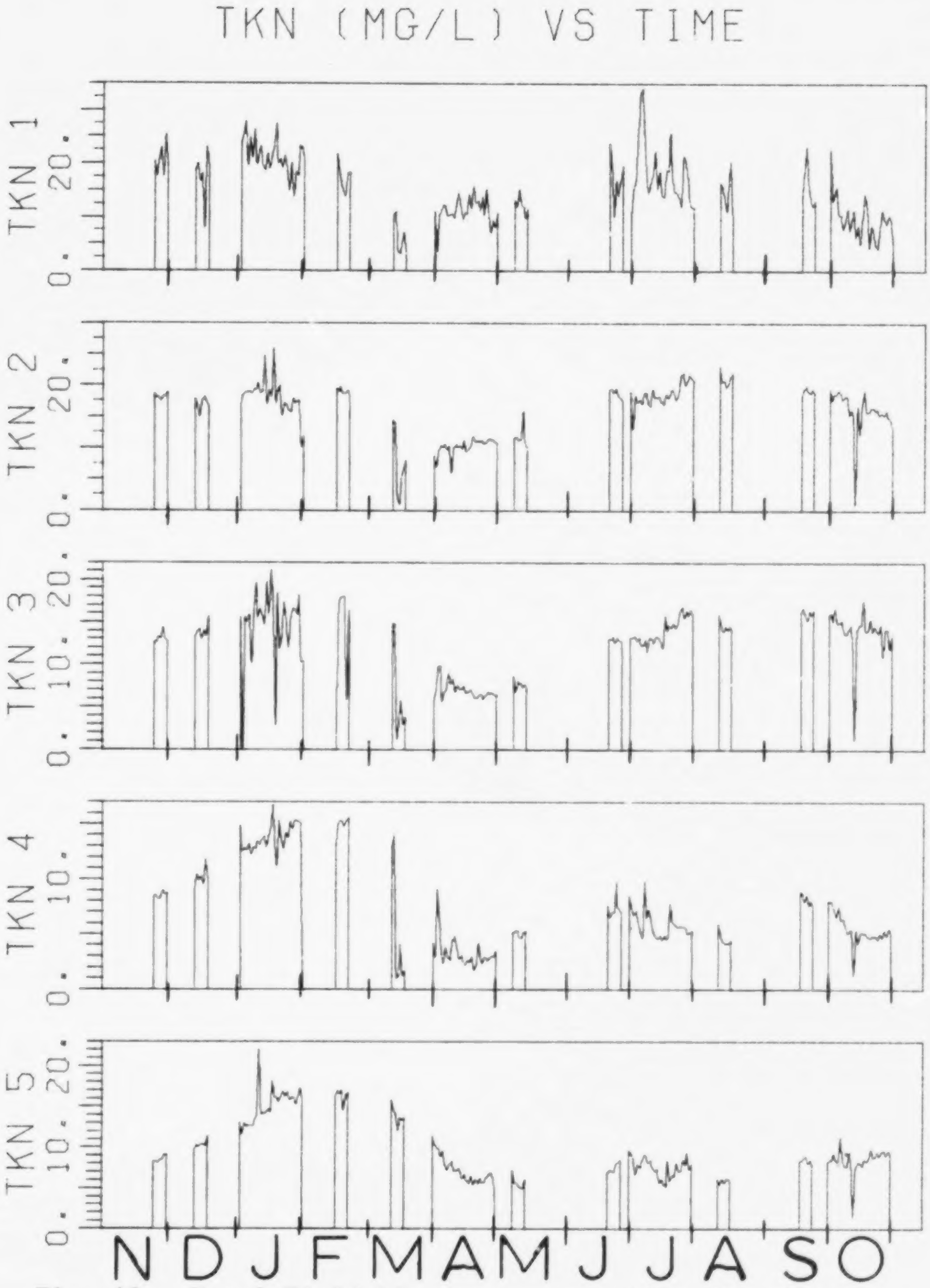

Fig. 41. Total Kjeldahl nitrogen vs. time for all sampling points.

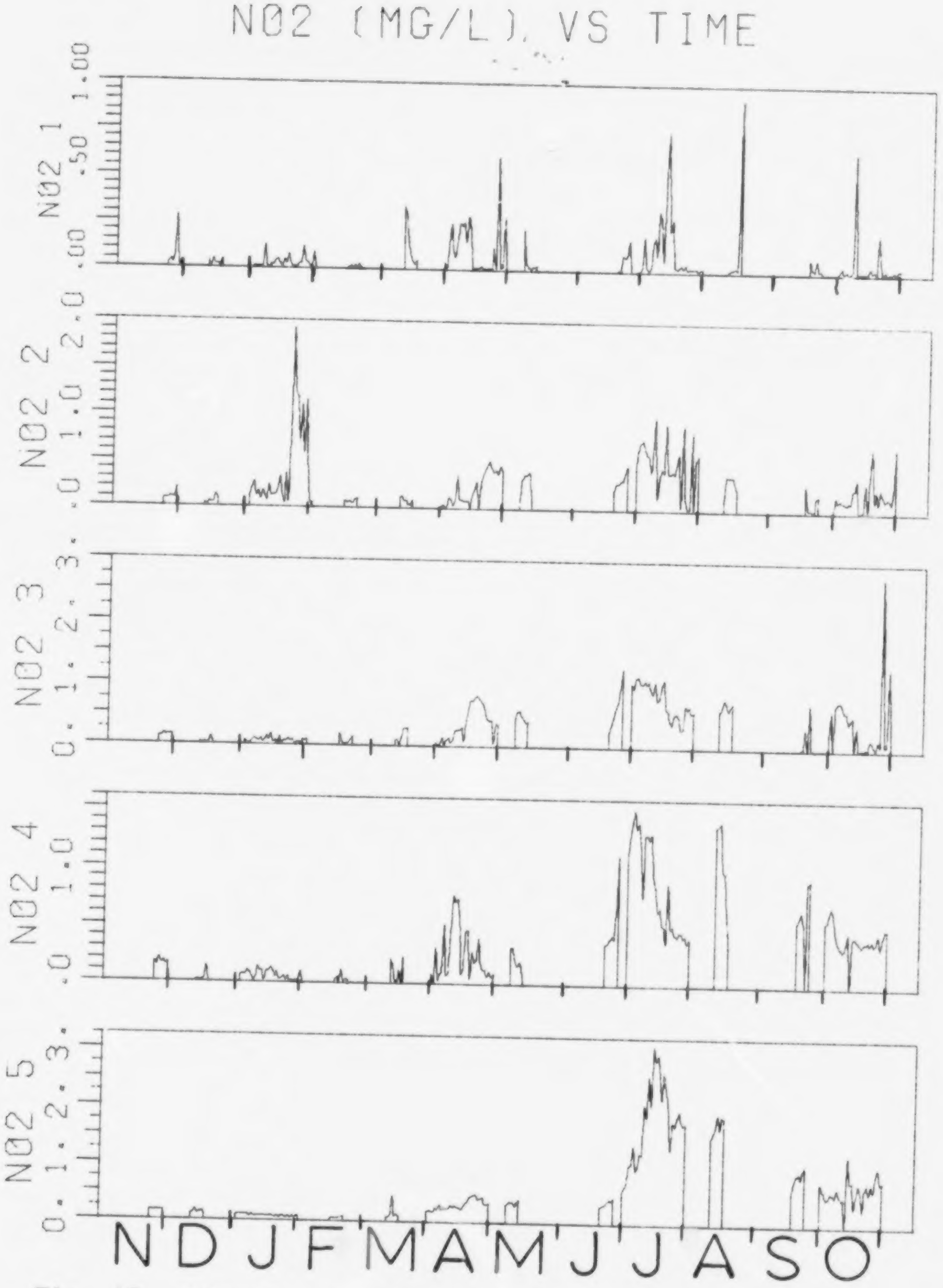

Fig. 42. Nitrite nitrogen vs. time for all sampling points.

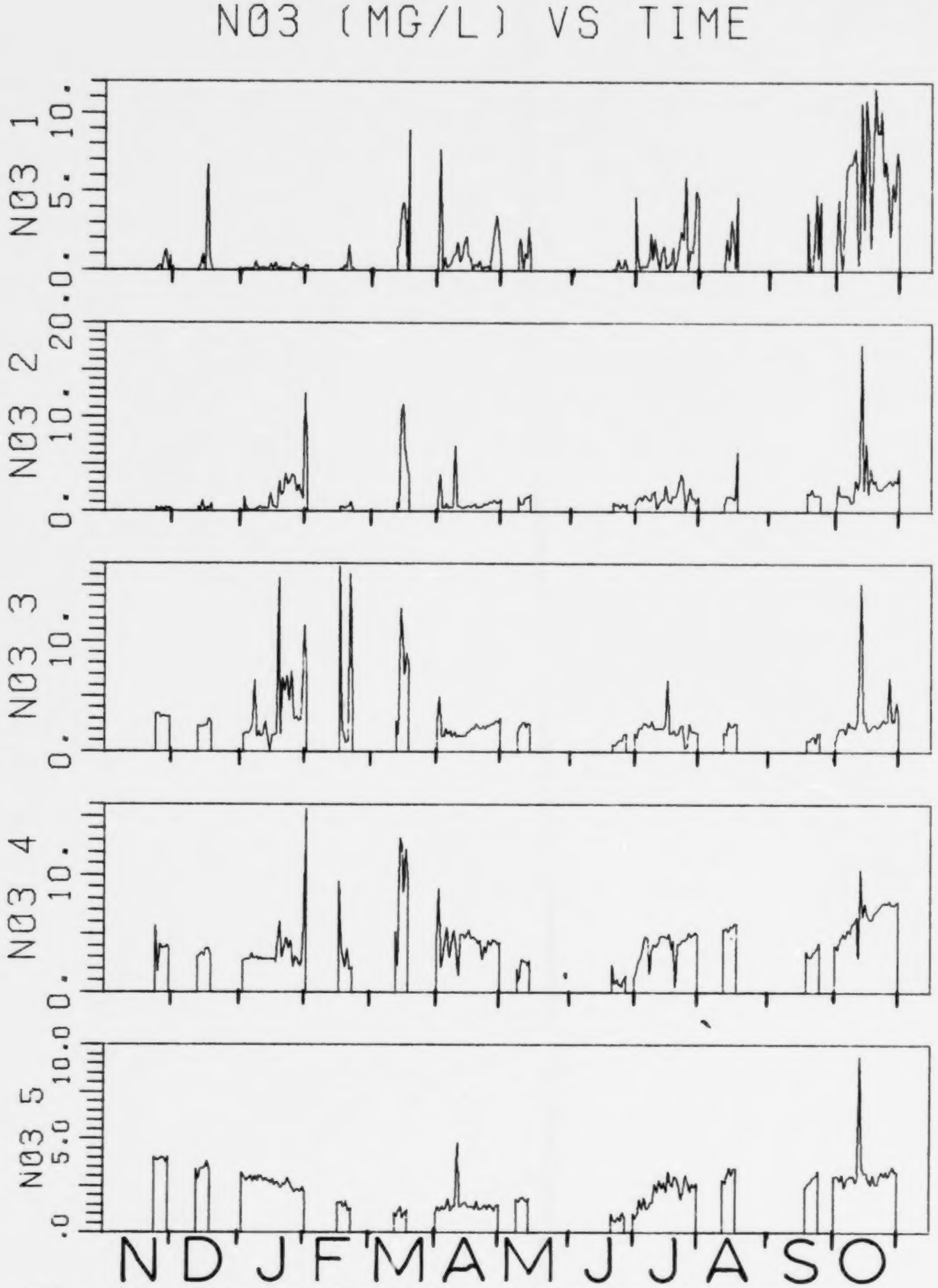

Fig. 43. Nitrate nitrogen vs. time for all sampling points.

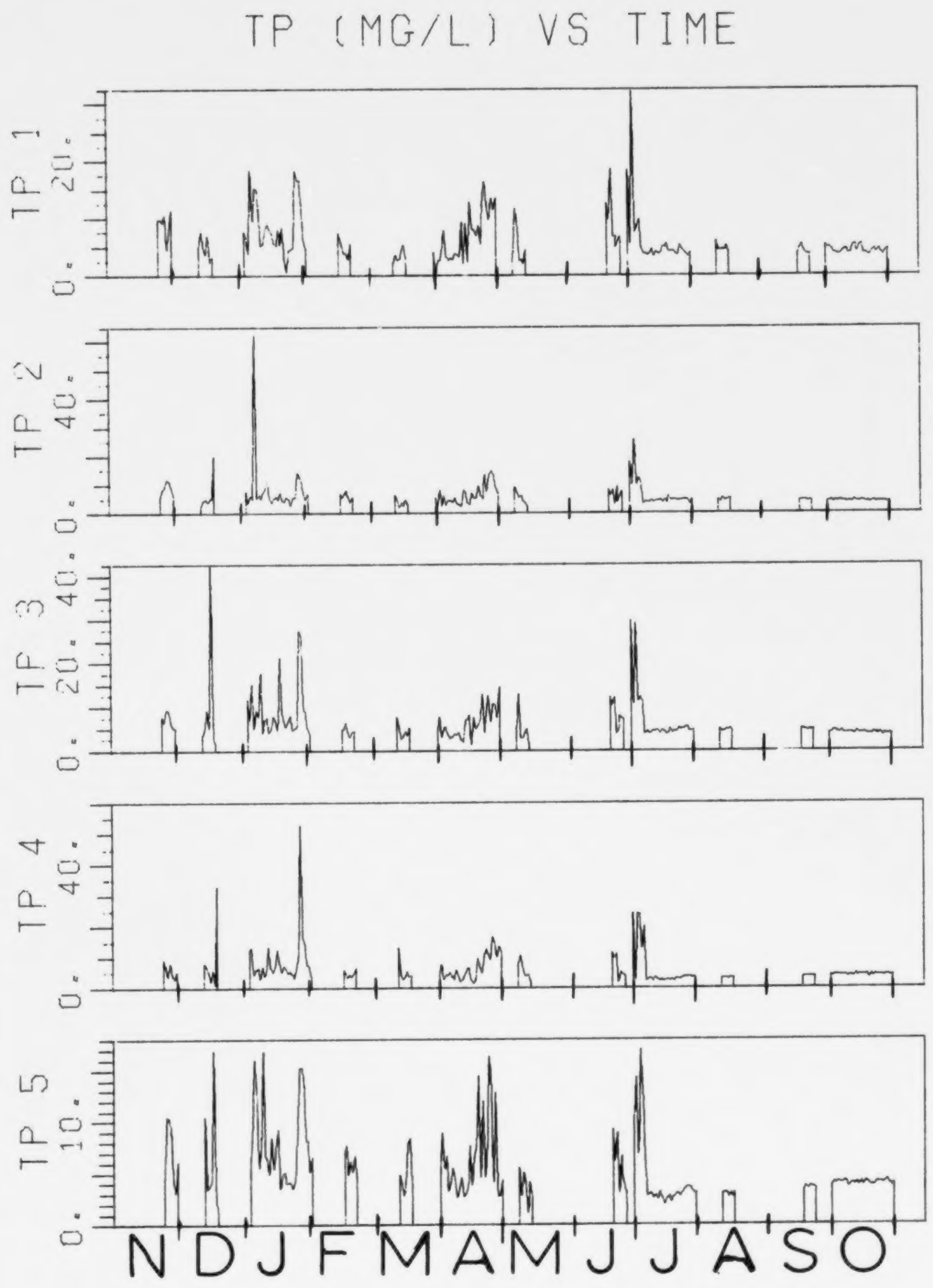

Fig. 44. Total phosphorus vs. time for all sampling points.

APPENDIX C

ALGAL IDENTIFICATION DATA

Date	Pond No. 1	Pond No. 2	Pond No. 3
2/16/76	> 500	5,000 Chlamydomonas	3,500 Chlamydomonas
3/14	150,000 Chlorella	75,000 Chlorella	50,000 Chlorella 1,000 Pediastrum 500 Scenedesmus
4/2	450,000 Chlorella	450,000 Chlorella	700,000 Chlorella
4/9	700,000 Chlorella	560,000 Chlorella 1,000 Pediastrum	1,000,000 Chlorella
4/16	440,000 Chlorella	10,000 Chlorella 1,000 Nitzchia	10,000 Chlorella
4/23	500 Chlamydomonas 500 Gonium	2,500 Scenedesmus 600 Chlorella 200 Pediastrum 500 Nitzschia	6,000 Scenedesmus 2,500 Chlorella
5/8	21,000 Chlorella	600,000 Scenedesmus 30,000 Protococcus 2,000 Navicula 24,000 Microactinium	26,000 Scenedesmus 1,500 Navicula 24,000 Microactinium
5/	200,000 Microactinium 23,000 Protococcus 2,000 Euglena	170,000 Scenedesmus 500 Pediastrum 32,000 Protococcus 50,000 Microactinium	50,000 Scenedesmus 500 Pediastrum 90,000 Protococcus 500 Navicula
6/22	32,000 Protococcus	500 Pediastrum 500 Closterium	500 Pediastrum

Note: All values shown in the above summary are expressed in cells/ml except for the Sp. of Pediastrum and Scenedesmus which are expressed as colonies/ml.

(continued)

ALGAL IDENTIFICATION DATA (concluded)

Date	Pond No. 1	Pond No. 2	Pond No. 3
7/5	100,000 Chlorella 10,000,000 Coelastrum	10,000 Chlorella 1,000 Closteridium 500 Pediastrum	4,500 Closteridium 2,000 Pediastrum
7/10	12,000 Chlorella 500,000 Coelastrum	500 Chlorella	5,000 Closteridium 1,000 Pediastrum 7,000 Scenedesmus
7/18	20,000 Chlamydomonas	1,000 Closteridium 500 Pediastrum 2,000 Microcystis	500 Closteridium 500 Pediastrum 1,500 Scenedesmus
7/25	30,000 Chlamydomonas	500 Chlamydomonas 500 Pediastrum 10,000 Scenedesmus	500 Pediastrum
8/14	500 Chlamydomonas	2,000 Pediastrum	1,500 Pediastrum 500 Closteridium 2,000 Oocystis
9/21	500 Chlamydomonas	2,000 Pediastrum	1,500 Pediastrum 6,000 Closteridium 250,000 Microcystis
9/28	> 500	2,000 Pediastrum 2,500 Scenedesmus	2,000 Pediastrum 2,000 Closteridium 200,000 Microcystis 1,500 Scenedesmus
10/2	> 500	1,500 Pediastrum 2,000 Scenedesmus	2,000 Pediastrum 4,000 Closteridium 100,000 Microcystis 500 Scenedesmus
10/9	> 500	1,500 Pediastrum 500 Scenedesmus	1,500 Pediastrum 500 Closteridium
10/21	> 500	> 500	> 500